THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LVI. No. 1442.] LONDON, DECEMBER 30, 1890. [42ND YEAR. Price 6d.

THE SILICA FIRE-BRICK COMPANY,
OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."
These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

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Manufacturers & Contractors.
THE ONLY MAKERS OF
PATENT ANTIMONY PAINT,
Parker's Imperial Black Varnish,
Oxide Paints, Oils, and General Stores for Gas and Water Works.
WORKS:
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WOLSTON'S
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Special Quotations to Gas Companies.
23, GREAT GEORGE ST., WESTMINSTER, S.W.

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EARLE'S
BEST
Portland Cement
MANUFACTURED BY
GEO. & THOS. EARLE,
HULL.
Office: 7, PIER STREET.
Works: WILMINGTON.
STOREAGE CAPACITY 10,000 Tons.
ESTABLISHED 1811—OVER THREE QUARTERS OF A CENTURY.
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Under G. R. HISLOP'S PATENTS
All Spent Limes are most effectually, economically, and continuously recovered, and at from one-third to one-half the cost of New Lime. The results are a surprise to all who have inspected the process, and are entirely satisfactory to all now using it. Descriptive Pamphlet and Terms from Agents as under.
— REGENERATIVE SETTINGS OF RETORTS. —
Hislop's Patent Producer and Patent Charging Appliances offer advantages which are unapproachable, while in every other detail his Settings are confidently recommended as being the most inexpensive and effective possible.
Illustrated Pamphlet and Terms on application to J. E. FISHER, Stourbridge, Agent for England and Wales; to C. M. HAMILTON, Portland Place, Hamilton, Agent for Scotland and Ireland; and for all other Countries to the Patentee,
Geo. R. HISLOP, Gas Engineer, PAISLEY, N.B.

C. & W. WALKER.
GASHOLDERS; PURIFIERS;
PURIFYING MACHINES;
CO_2 AND TAR-EXTRACTING WASHERS; SCRUBBERS;
SULPHATE & SULPHUR PLANT;
RETORT MOUTHPIECES; CONDENSERS;
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SLIDE VALVES; TAR BURNERS; &C., &C.
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"FORTRESS LONDON." "FORTRESS DONNINGTON."—Telegraphic.

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Manufacturers of

IMPROVED CONSUMERS' WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

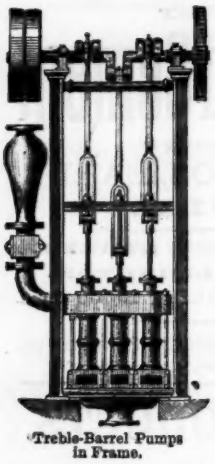
AND

IMPROVED DRY GAS-METERS;

Also Sole Makers of THORP AND MARSH'S PATENT CASH PREPAYMENT ATTACHMENT FOR GAS-METERS.

STEAM & HAND PUMPS FOR GAS-WORKS.

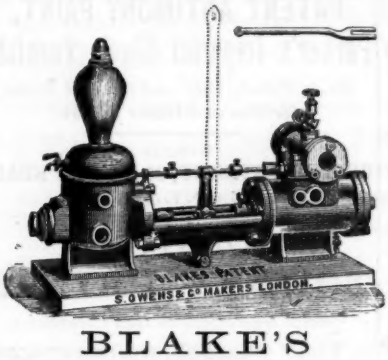
FOR PUMPING TAR, WATER, AND LIQUOR.



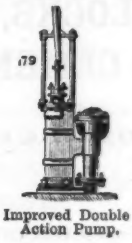
Treble-Barrel Pumps in Frame.

Syphon Pump.

Double-Barrel Force-Pump in Frame.



BLAKE'S
PATENT
STEAM PUMPS.
20,000 IN USE.



Improved Double Action Pump.

Cast-Iron Hand-Pump.

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SLIDE VALVES,
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AND
Gasholder Tanks.

CAST-IRON RETORTS,
RETORT-BED FITTINGS,
And Retort-House Appliances
of every description.
Iron Roofs, Columns, Girders, Floor Plates and Tools, &c.

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CONDENSERS,
SCRUBBERS, & WASHERS,
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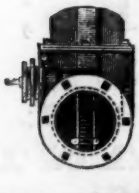
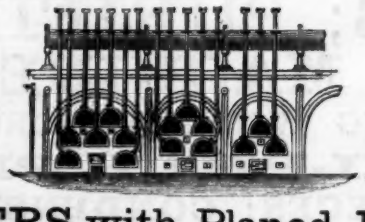
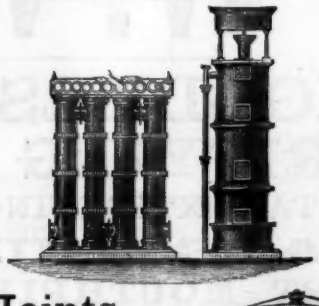
CENTRE VALVES
for working Purifiers.
Also Bye-Pass & Stop Valves.







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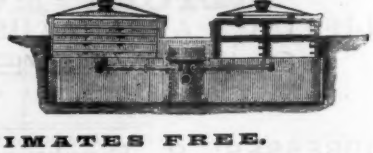

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Pig Iron (*Special Quality*) for ENGINE CYLINDERS, &c.

GAS COAL FAMOUS FOR ITS UNRIVALLED EXCELLENCE.

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Telegraphic Address:
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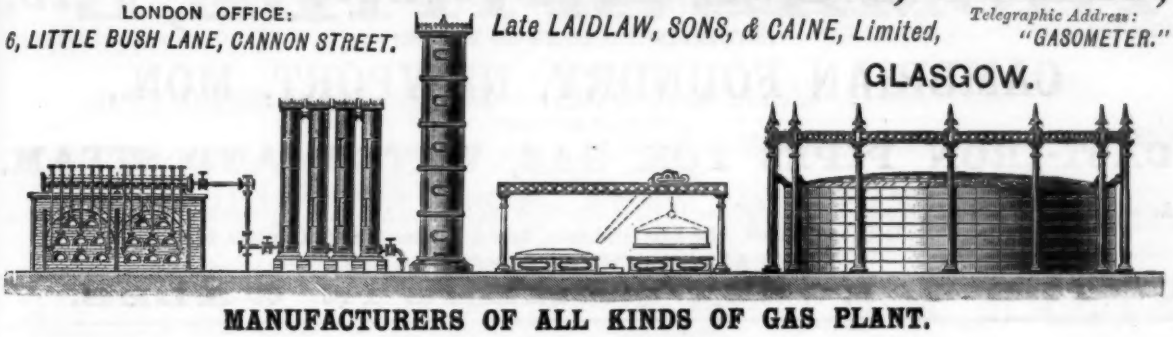

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RETORT-BENCH FITTINGS; SIEMENS'S REGENERATIVE AND ORDINARY FURNACES;
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IRON ROOFING, MARKET BUILDINGS, BRIDGES, GIRDERS, STEAM BOILERS;
PROMENADE PIERS AND LOADING WHARVES.

MANUFACTURERS OF OIL PLANT OF EVERY DESCRIPTION.

HENDERSON'S Patent Retorts, Condensers, Stills, Cast and Wrought Iron Tanks, Ammonia Stills, Wrought-Iron Gas-Mains, &c., &c.

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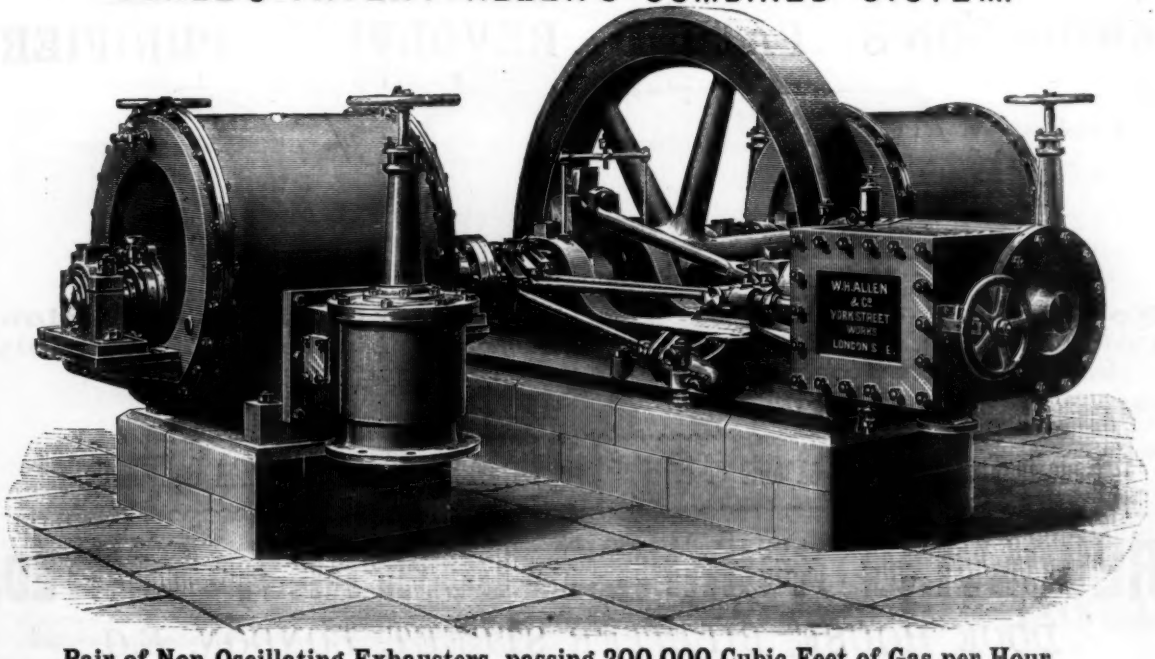
MAKERS OF THE MOST IMPROVED FORM OF

GAS EXHAUSTING MACHINERY.

BEALE'S PATENT—ALLEN'S COMBINED SYSTEM.



Pair of Non-Oscillating Exhausters, passing 200,000 Cubic Feet of Gas per Hour.

CAST-IRON PIPES, ETC.

THOMAS SPITTLE, LTD.

[ESTABLISHED OVER 50 YEARS.]

CAMBRIAN FOUNDRY, NEWPORT, MON.,

MAKERS OF

CAST-IRON PIPES FOR GAS, WATER, AND STEAM.

ALSO

Retorts, Mouthpieces, Lamp-Posts, Hydraulic Mains, H-Pipes, Dip-Pipes, Buckstaves, Ash-pans, Sight-Holes, Syphons, Ascension-Pipes, Fire Doors and Frames, Fire-Bars, Hydrants, Valves, Purifiers, Tanks, Columns, &c., &c.

ALSO ALL WROUGHT-IRON WORK.

THE LARGEST MAKERS IN WALES.

ESTABLISHED 1825.

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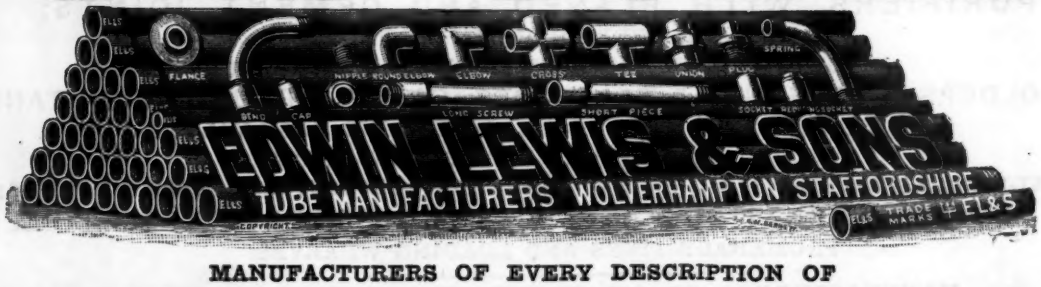

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IRON OR STEEL LAP-WELDED OR BUTT-WELDED TUBES

FOR ANY PURPOSE.

WATER PURIFICATION.

RIVER WATER and SEWAGE EFFLUENT successfully and economically treated in large volumes, by AGITATION WITH METALLIC IRON in

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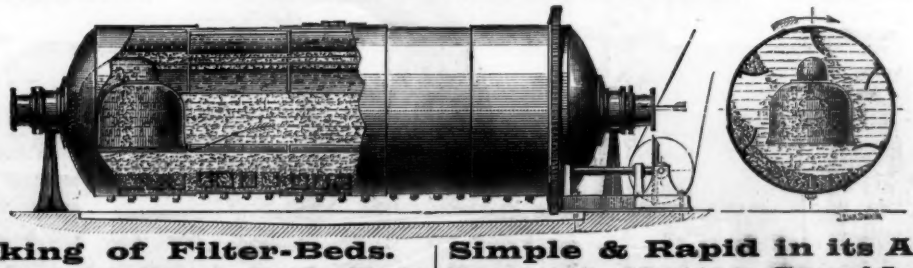

No Choking of Filter-Beds.
Colour due to Peat and Clay entirely Removed.
Simple & Rapid in its Action.
Organic Matter Considerably Reduced.
Microbes Totally Removed.

Made in Fourteen Sizes, capable of treating singly from **4000** to **1¼** Million Gallons daily.

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DOCK HOUSE, BILLITER STREET, LONDON, E.C.

CARLESS, CAPEL, & LEONARD,

HOPE CHEMICAL WORKS, HACKNEY WICK, LONDON, N.E.,

NAPHTHA & GASOLINE DISTILLERS & PETROLEUM IMPORTERS,

SPECIALLY PREPARE GASOLINE OF ANY SPECIFIC GRAVITY BEST ADAPTED FOR CARBURETTING GAS; ALSO PETROLEUM ETHERS OF CONSTANT BOILING POINTS.

Prices and Samples may be had upon application.

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INCORPORATED IN THE LEEDS FIRE-CLAY COMPANY, Ltd.,

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MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

ESTABLISHED MORE THAN A QUARTER OF A CENTURY

WORKS HUNSLET, LEEDS

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MAKE A SPECIALTY OF GASHOLDERS

AND MAKERS OF GAS PLANT OF EVERY DESCRIPTION.

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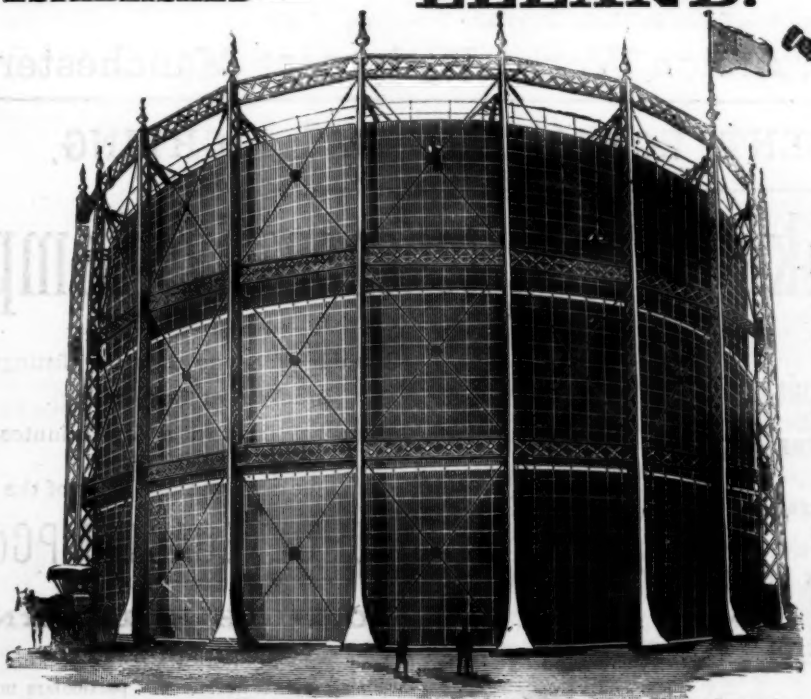
R. DEMPSTER & SONS, Ltd.,

ROSE MOUNT GAS ENGINEERING WORKS,

ESTABLISHED — **ELLAND.** — 1855.



The above Illustrates a TREBLE-LIFT GASHOLDER, 194, 191, and 188 feet diameter by 85 feet deep each, as made for the MELBOURNE GAS COMPANY.

GAS AND CHEMICAL PLANT OF EVERY DESCRIPTION — ALL SUNDRIES SUPPLIED.

OUR

ROTARY EXHAUSTERS

Are acknowledged to excel in efficiency and finish.

OUR IMPROVED

COKE-BREAKING MACHINE

Is a pronounced success.

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JOHN HALL & CO.,

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MANUFACTURERS OF FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

RETORTS CAREFULLY PACKED FOR SHIPMENT.

A STOCK OF DIFFERENT SHAPES ON HAND.

GAS AND WATER PIPES

AND

CASTINGS OF EVERY DESCRIPTION.

MANUFACTURED BY THE

CLAY CROSS COMPANY,

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SULPHATE OF AMMONIA.

By Her Majesty's Royal Letters Patent.

DR. FELDMANN'S APPARATUS

The most successful and approved Apparatus known up to the present time.

FOR REFERENCES, PARTICULARS, TESTIMONIALS, AND PRICES APPLY TO THE

Sole Agents and Manufacturers,

GODDARD, MASSEY, & WARNER,

ENGINEERS,

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The Apparatus has been supplied to the following Firms—

BURT, BOULTON, & HAYWOOD, SILVERTOWN, and ELING.
CHANCE BROTHERS, OLDBURY (4 Apparatus).
RUNCORN SOAP & ALKALI CO., Limited, RUNCORN.
NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited, SHADWELL.
WM. BUTLER & CO., BRISTOL.
KEMPSON & CO., Pye Bridge.

And to the following Gas Companies and Corporations—

ILKESTON.	BURY.	CHORLEY.
WIDNES	BRIGHOUSE.	WHITEHAVEN.
HALIFAX.	MARKET HARBRO'.	CHESTER.
ALTRINCHAM.	PRESCOT.	SOUTH SHIELDS.
DENTON.	SOWERBY BRIDGE.	LEEK.
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FACE YOUR RETORT MOUTHPIECES.

JOHN RUSCOE calls attention to his Retort Mouthpiece and Lid Facing Machines, which are in extensive use; also to his Lathes, Drilling, Slotting, Grooving, and Planing Machines, Smiths' Hearths, Smithy Fans, Roots' Blowers; also special Screwing Machines for Gas Tubes and Bolts, Taps, Wrenches, Pipe Cutters, special Taper and Twisted Rymers, Drills, &c.

PATENT TWISTED TAPS, DIES, & CUTTERS.

Thousands in constant work, give universal satisfaction.

Work Easier, Less Friction, Last Longer, and do Better Work than straight Grooves.

Main Drilling Stand, with Cup Drills, 1¼ to 6 inch; Taps, Rymers, and Drills.

Ratchet Screwing Stocks, and Adjustable Once-up Stocks, Dies, Guides, &c.

Inquiries and Trial Orders Solicited. Everything Guaranteed. Apply to

JOHN RUSCOE, Albion Works, Hyde, near Manchester.

SIXTY PER CENT. ECONOMY IN GAS LIGHTING.

The Schülke Regenerative Lamp

FOR

DOMESTIC AND EXTERNAL LIGHTING.

The only Regenerative Lamp employing the Common Flat-Flame Burners.

Lamps giving 20-Candle power consume less than four feet of Gas per hour.

PURE WHITE & PERFECTLY STEADY LIGHT,

NOT AFFECTED BY DRAUGHTS.

Suitable for any existing fittings (Brackets or Suspending).

Can be fixed in a few minutes.

May be seen at the Offices of the

SCHÜLKE GAS-LAMP Co.

LIMITED,

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LONDON, W.C.,

Where Price Lists and full particulars may be obtained.

KIRKHAM, HULETT, & CHANDLER'S, LTD.,

[SIDNEY HERSEY, Managing Director.] **NEW PATENT** [J. CHANDLER, Engineer.]

"STANDARD" WASHER.

EXTRACTS the WHOLE of the AMMONIA

Also a Large Proportion of H_2S and CO_2 from Gas.

Has been in operation over two years at the Beckton Station of The Gaslight and Coke Company. (See below.)

TESTIMONIAL FROM THE CHIEF ENGINEER OF THE GASLIGHT AND COKE COMPANY.

The Gaslight and Coke Company, Horseferry Road, Westminster, S.W.,
Nov. 25, 1889.

Messrs. KIRKHAM, HULETT, AND CHANDLER, LIMITED,

GENTLEMEN,—In reply to your enquiry respecting the result of putting "Wooden Bundles" into some of the Washer-Scrubbers at our Beckton Station, I beg to say they have answered admirably for the few months they have been in; and I think them a decided success.—I am, yours truly,

(Signed) G. C. TREWBY.

NOTE.—The first Washer referred to in the above was fitted with improved "Bundles" in May, 1888; *and these have proved so satisfactory that The Gaslight and Coke Company have had several other "Standard" Washers fitted in the same manner, and have recently given an order for machines for* 6,000,000 *cubic feet per day.*

For List of "Standard" Washer-Scrubbers supplied of above-mentioned pattern and renewals effected by application of same to old pattern machines, see last and next weeks' issue of the JOURNAL.

PALACE CHAMBERS, BRIDGE STREET,

WESTMINSTER, S.W.

R. & J. DEMPSTER,

GAS PLANT WORKS, NEWTON HEATH, MANCHESTER,

MAKERS AND ERECTORS OF

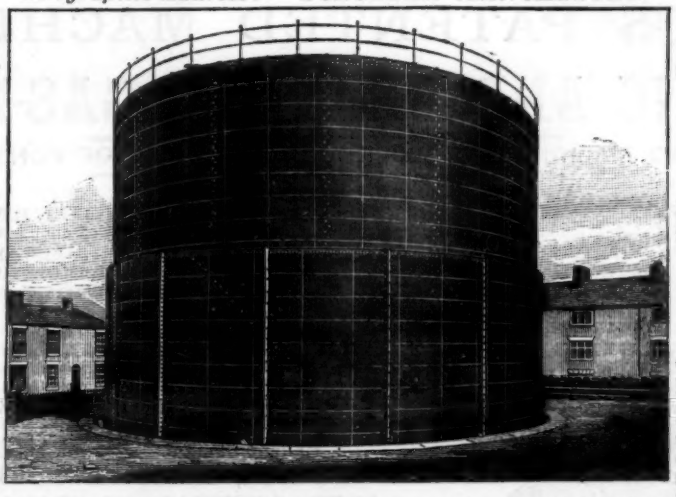
PATENT COLUMNLESS GASHOLDERS.

Telegraphic Address: "SCRUBBER MANCHESTER."

TOTAL WEIGHT REDUCED
from 30 per cent. to 50 per cent.

TRANSPORT AND ERECTION REDUCED
to the same extent; and in cases where gasholders are shipped abroad to places difficult of access, this represents a very large amount of money.

TANK CONSTRUCTION SIMPLIFIED.
The Tank wall (of whatever construction) is a regular cylinder. There are no piers needed, and all expensive foundation stones for the base of columns or standards are dispensed with.



Two-Lift Gasholder erected at the Gas-Works, Northwich, which has been in continuous work since Jan. 3, 1890, and has been subjected to most severe tests from heavy gales, with perfectly satisfactory results.

COST OF PAINTING SAVED
for the Columns and Girders.

TILTING UTTERLY IMPOSSIBLE;
And as there are fewer parts, there is less liability for the Gasholder to get out of order in working.

STABILITY UNDER WIND PRESSURE
of a Gasholder constructed upon this system is at least equal to, and from experiments and calculations made is far in excess of, that of a Holder of the same dimensions guided by the elaborate guide framing at present in use.

The removal of heavy guide carriages and rollers from the top curbs considerably lowers the centre of gravity of the structure, and dispenses with the extra strength of sheeting necessary to carry these at the points where they are attached to the gasholder.

The plan adapts itself to telescoping to any reasonable extent, and enables very shallow holders or lifts to be employed with perfect stability.

FOR FURTHER PARTICULARS AND ESTIMATES, APPLY TO THE ABOVE.

HANNA, DONALD, & WILSON,

(Established 1851),

GAS ENGINEERS & CONTRACTORS,

Abercorn Foundry and Abbey Works,

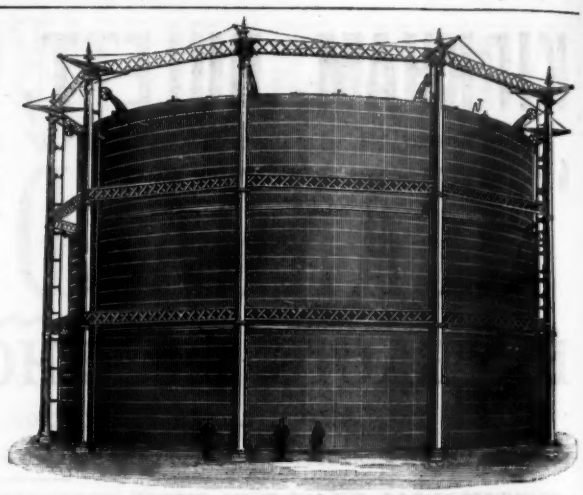
PAISLEY, N.B.,

MAKERS OF

Gasholders and Gas Plant

OF EVERY DESCRIPTION.

Telegraphic Address: "Donald Paisley."



THE ALBO-CARBON LIGHT.

ESTABLISHED TWELVE YEARS. Hundreds of thousands in use.

UNEQUALLED FOR BRIGHTNESS, SOFTNESS, & ECONOMY.

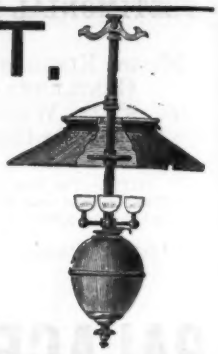
SINGLE LIGHTS FROM 6s UPWARDS. CLUSTERS FROM 40s. TO 145s.

SAVE half your Gas Bill. The Greatest Success of the Day.

Albo-Carbon, genuine fluted, 18s. cwt., 3d. lb.

AGENCIES GRANTED. LIBERAL TERMS.

FOR PRICES, ETC., ADDRESS



6-Light Shop Pendant. 52s. complete.

ALBO-CARBON LIGHT COMPANY, LIMITED, 74c., JAMES STREET, WESTMINSTER, S.W.

WEST'S GAS IMPROVEMENT Co., Ltd.,

Engineers, Ironfounders, & Contractors,

ALBION IRON-WORKS, MILES PLATTING, MANCHESTER,

MANUFACTURERS OF

WEST'S PATENTED MACHINERY FOR CHARGING AND DRAWING GAS-RETORTS.

OVER 180 MACHINES AT WORK AND IN COURSE OF CONSTRUCTION.

Advantages attending its use are:

INCREASED VOLUME of GAS per TON, and INCREASED YIELD per Retort.—The system of breaking and distributing the coals in an even layer in the retorts effecting more perfect carbonization.

REDUCTION in LABOUR and COST of WORKING.—In Works where this System of charging and drawing Retorts is adopted, there has been effected a substantial saving in the cost of Gas Manufacture in the Retort-House; the amount saved varying in different Gas-Works from **8 PENCE** to **15 PENCE per Ton** of coal carbonized. Full particulars will be forwarded upon application to W. G. I. Company, Limited.

MANUAL CHARGING AND DRAWING MACHINES.

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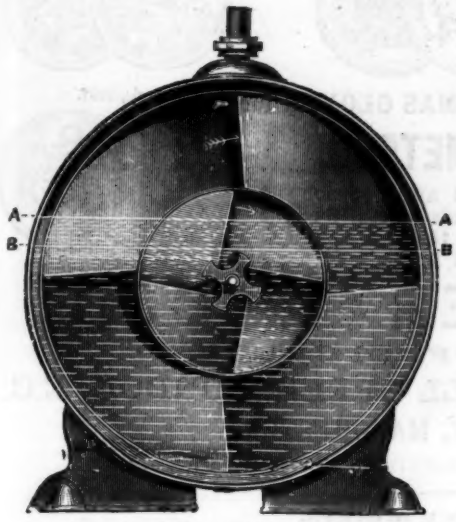
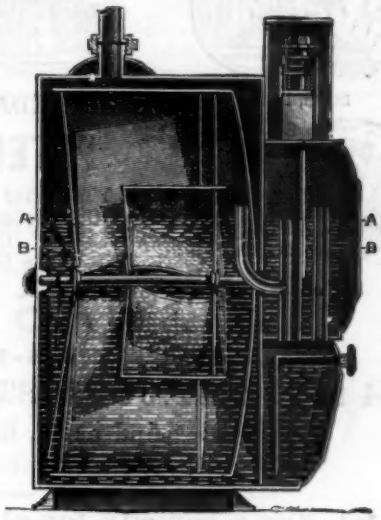


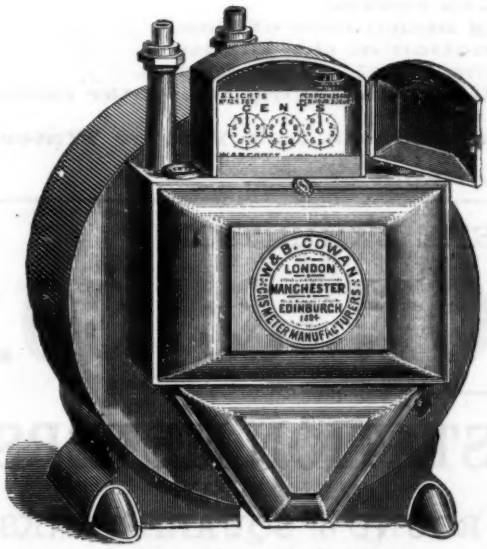
A A, High-Water Line.

B B, Low-Water Line.

Drum in Case. Hollow Cover removed.



Sectional Side View of Meter.



Elevation showing Tin Case Meter.

Elevation showing Cast-Iron Case Meter.

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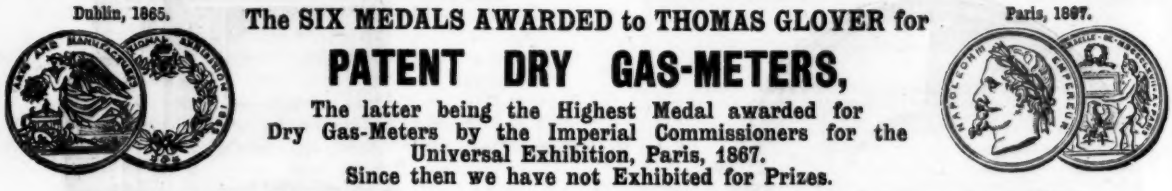

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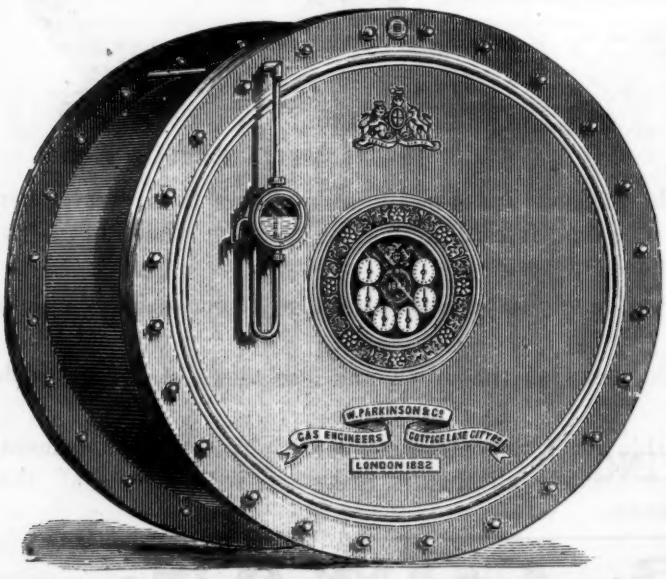

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[See also Advt., p. 1364.

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, DECEMBER 30, 1890.

1890.

A Retrospect of the Year.

ONCE more we stand face to face with the most striking reminder of the flight of time—the dividing-line between one year and the next. There is nothing novel in the reflection; for the course of time has furnished a theme for moralists of all ages, and nobody can hope to suggest a new thought or teach a fresh lesson with reference to such a worn subject. One can use the term "worn" advisedly in connection with this line of reflection, but it would be wrong to call it worn out; for the flight of time can never be an empty consideration for mortal humanity. Much has passed since we last preformed our annual duty of chronicling the year's developments of the great national industry with which the JOURNAL is identified; yet much remains the same. It is difficult, the moment a year draws to its close, to say positively whether or not its events have been more important than those of any other year. This may generally be found with greater certainty later. Transactions seldom disclose their true value in the eyes of contemporaries; and it is usually safer and easier to recognize an important era some years after its events have become history, than immediately after they have happened. It would be difficult to say off-hand for what controlling incidents in respect of the gas industry the year 1890 has been distinguished. To some of our readers, of course, it has been a period of agitation and excitement, big with Fate for them and their concerns; while for others it has passed quietly enough. For the country generally, in its industrial aspect, the year has been very fairly prosperous. The movement that began some years ago with the gradual absorption of the spare fuel of the country has continued; and it is therefore possible to say with truth that trade was, on the whole, good in 1890. An eminent statesman once declared that the condition of the chemical trade affords a conclusive indication of the state of commerce generally. Whatever may be the case with chemicals, the remark indubitably holds good for coal. When coal is dear, and gas coke goes off well, trade must be good. This year coal has been remarkable for a great advance in value. Last winter it was not to be had except with difficulty by many gas undertakings, whose contracts could only be renewed in the summer at considerable advances. Coal-owners saw their advantage in this, and pinched some Gas Companies very hard when the opportunity came. Their plans were furthered by the administrators of some important gas undertakings, who lost their heads in what they conceived to be a great emergency, and paid anything that was demanded for assured supplies. At one time an advance of 4s. per ton, or more, was marked in the price of gas coal as compared with the price a twelvemonth earlier; and although the resolute attitude of many large buyers broke the combination that had been formed with the object of keeping coal exorbitantly high in value, no contracts could be made for fresh supplies, except at a considerable advance on the old rates. Whatever else it may be remembered for in the gas industry, therefore, 1890 will be known as a year of dear and scarce coal.

This condition had in many places a disastrous effect upon the revenue prospects of gas undertakings; and consequently advances in the price of gas were notified in various quarters. This effect was also due in a large degree to dearer labour. When we published our last "Retrospect," it was in the midst of the most important labour agitation of recent times, which had a particular bearing upon the gas industry. What is now known as the New Trades Unionism arosei n 1889, and has disturbed the industry of the country ever since. This movement, which has been abundantly discussed in the JOURNAL, was the combination of labourers engaged in all industries with the object of obtaining, under pressure, higher wages and reduced hours of labour from employers. The New Trades Unions differed from the old in being composed of associated labourers, mostly unskilled, or at best trained in different kinds of rough work, instead of being restricted to tradesmen, and in being organized for fighting only, without embracing sick relief. The history of one of the chief of these Unions—that of the Gas Workers and General Labourers—was partly told at the end of 1889, which closed in the midst of an attempt to force the South Metropolitan Gas Company into subservience to the Union. All the stokers of the Company who had joined the Union were called out three weeks before the end of last year; and the strike was supposed to have lasted for several weeks into 1890. The result of the conflict, however, was from the first disastrous to the Union, the leaders of which were directly responsible for throwing 2000 men out of employment in the depth of winter. The relations of workmen with

their employers were very strained in most trades throughout the year. Strikes at the Leeds and Bristol Gas-Works ended in victories for the men, through bad management on the other side. Wherever this condition did not prevail, the inherent weakness of the Union policy caused its defeat. The most instructive of all the strikes of 1890 was that of the Melbourne labourers, because it exemplified the practical working of two of the fundamental points in the New Unionist Charter—the denial of employment to non-unionists, and the Federation of Unions. It is essential for the success of the New Unionist movement that it should possess complete control over employment, and that all federated Unions should act in unison for mutual support. The Melbourne labour war demonstrated the weakness of the New Unions in both respects. Unfortunately, at the present moment, 10,000 railway workers in Scotland are illustrating the difficulty of teaching demagogue-led mobs except by experience. The strike mania which affected gas workers a year ago is now raging in the South of Scotland, to the immeasurable inconvenience of the whole community, among the servants of the principal railway companies. It is certain, however, that without outside support the movement must come to an end. A remarkable development of the Socialistic side of the labourers' agitation was the demand for a legislative eight-hour day.

The financial world has been busy, as usual, during the year; and speculation has been rife. A disaster that must have been wide-spreading in its effects upon British commerce was averted by the arrangements made for settling the affairs of Baring Brothers, whose troubles mainly arose out of the extraordinary condition of affairs in Argentina, where the gas industry has of late years made much progress. Capitalists interested in gas were considerably exercised with regard to two competing schemes for investing British money in United States gas undertakings, which caused a good deal of going to and fro between London and New York of prominent gas financiers and consulting engineers; but in the end both projects fell through. The collapse in South African ventures also had bad results in regard to a certain division of the gas interest. Attempts were made at different times during the year to drag gas stock into the whirl of speculative finance; but without success. The dramatic exposure, towards the end of the year, of the methods whereby investors are imposed upon by organs of so-called independent expert opinion, like the *Financial News*, which was once inspired to make a bitter attack upon prominent men in the gas world, will, it is hoped, have a good influence upon the investment market.

Much has transpired in the commercial world to interest and instruct the friends of the gas industry. A most important piece of business has been the revision of railway rates, which closely affects gas undertakings. A Special Committee, mostly of Midland gas manufacturers, has been engaged in watching this matter; and the conclusion of their labour has not yet been reached. The successful formation of the Alkali Union, upon the lines of the previous consolidation of the salt interest, is a noteworthy sign of the times, which favour the concentration of large industries in few hands. Attempts to similarly fuse the fire-brick and coal interests respectively have not been successful; but it would be rash to set a limit to this tendency. A year ago it was rumoured that the trade in a commodity of particular interest to the gas manufacturer—mineral oil—might possibly be concentrated into one monopoly, with the effect of raising prices. But this has not been done; and oil of all grades is very cheap again. This is a weighty consideration for the gas manufacturer, whether he regards oil as a prospective raw material for his own use, or in its refined state as a competitor in the field of artificial lighting.

There has been little legislation this year for the gas industry. A point of serious, but local importance was settled by the Metropolis Management Amendment Act, which forbids interference with the subsoil of roads in which gas-mains have been laid. This enactment settled a grievance of long standing, and removed a source of danger to the public. The failure of the Partick, Hillhead, and Maryhill Gas Company to obtain statutory powers, and the conflict over the Whitehaven Gas Bill, were the most considerable incidents in the Private Bill Legislation of the year as affecting gas supply. The grant, through the Board of Trade, of statutory powers to the first British Water Gas Company, formed to supply Llandrindod Wells, is an incident worthy of being chronicled.

In the Law Courts the most celebrated gas suit of the year was that of The Gaslight and Coke Company against the South Metropolitan Company for damages arising out of the encroachment of the latter (under circumstances fully reported at the time) upon the parliamentary district of the former. The effect of the judgment in this case is to carry the supposed point of the sale of gas from the meter to the burner. A long agitation was brought to a close, for the time being, by the arbitration between the Dublin Corporation and the Alliance and Dublin Consumers' Gas Company, which settled the terms upon which the control of the public lighting arrangements should be undertaken by the former. The scandalous proceedings arising out of the Hunter frauds at Salford culminated in the exposure of Mr. Ellis Lever as one of Hunter's accomplices, and his condemnation to pay a heavy penalty to the Corporation. For our own share in this particular matter, we had to bear our costs in the outrageous action of *Fox v. King*, which illustrated the risk run by the conductors of a public journal who refuse to sell their consciences. The Chief Gas Examiner for the Metropolis—Dr. A. W. Williamson, F.R.S.—had to defend himself against an attempt on the part of The Gaslight and Coke Company to force him to hear counsel on their behalf, in appeals to his authority. The same Company, together with the Brentford Company, have given notice of their intention to move Parliament with regard to clearing up doubts on the law of cutting-off notices, which was called in question by the decision of a County Court Judge at Brentford. Altogether, therefore, the law business of the year was not heavy, so far as Gas Companies were concerned.

It is particularly difficult to assign exact dates to new discoveries and inventions, because of the discrepancy between the actual date of publication of any new departure and that of its definite acceptance in the world of industry. To all intents and purposes, the Coze inclined retort system and its English adaptations by Messrs. Morris, Van Vestraut, Trewby, and Kitt, mark the year, although they are not strictly confined to it. The same may be said of the various water-gas systems that came into prominence like novelties during the year. Although none of the water-gas plants exhibited and tried with varying success in the United Kingdom in the past year actually originated within this period, to all intents and purposes 1890 was the year of the dawn of water gas for this country; its prospects being, like those of the inclined gas-retort, enhanced by the circumstance of dear coal and labour. Prepayment gas-meters, again, came a little more into vogue during the year, as progress was made in different places with the cultivation of the small consumer. Various systems are now followed with this object in large and small towns, the results of which cannot fail to be interesting when sufficient time has been allowed to pass for thoroughly testing them. The year has seen a novelty in carburetting gas on the large scale; the high price of suitable cannels and the exigencies of the London Gas Referees acting in combination to induce Metropolitan gas managers to use gasoline for this purpose. The Maxim and Clark carburetting apparatus has been successfully introduced into several gas-works. A proposal originating with Mr. Tatham, of New South Wales, was made for the utilization of oxygen prepared by the Brin process, as perfected by Mr. W. A. Valon, in combination with hydrocarbon gas, for lighting purposes; and another commercial oxygen process—Mr. Bowman's system—was brought forward. The latter is an improvement on the Tessié du Motay process. The erection of gasholders with modified guide-framing, or without fixed upper guide-framing at all, progressed considerably during the year, in the hands of Mr. George Livesey, as also of Messrs. Gadd and Mason and Mr. E. Lloyd Pease. Among the notable discoveries of the year must be included that of coal underlying the chalk in Kent.

The Gas Institute met at Ryde, Isle of Wight, in June, under the presidency of Mr. George Garnett, M. Inst. C.E. The meeting was numerously attended; but the proceedings were largely of a holiday character. A new constitution and code of rules were adopted at the meeting; and the Institute was subsequently incorporated as a Limited Company, without the use of the word "Limited"

in its title, under the Joint-Stock Companies' Acts. In the process, its name was changed, at the instigation of the Board of Trade, to the Incorporated Gas Institute. A new Secretary, Mr. W. H. Harvey, was appointed in the place of Mr. W. H. Bennett, resigned. Readers curious to know the nature of the transactions at the meeting must consult the files of the JOURNAL; for the year has closed without the appearance of the usual official volume. A new national association of gas engineers and managers was also registered under the name of the Incorporated Institution of Gas Engineers; the President-Elect being Mr. G. C. Trewby, Chief Engineer of The Gaslight and Coke Company, and the Honorary Secretary, Mr. James L. Chapman, of Harrow. The circumstances that have eventuated in these proceedings are too well known to our readers to need re-statement here. They mark a complete stage in a long and somewhat tedious drama. All the different District Associations of Gas Managers fulfilled their purposes very creditably during the year. There was in some of these societies a marked increase of the tendency to postpone discussions from one meeting to another, which requires to be checked. The office of a supreme authority on gas matters (apparently in suspense) was assumed for the nonce by the Society of Arts, who arranged for the delivery of a series of Cantor Lectures by Professor Vivian B. Lewes, F.I.C., F.C.S., that constitute a very valuable addition to the technical literature of gas manufacture.

The electric lighting industry has, in a sense, prospered during the year. Provisional Orders under the Electric Lighting Acts have been applied for by a large number of local authorities, with the object of preventing speculative companies from obtaining statutory rights over their districts. So far as we have been able to gather the facts, however, not a single municipal electric lighting plant was actually started during the year. The only working undertaking of the kind in England designed for doing a general business—that at Bradford—was discovered to be entailing a heavy loss upon the proprietors. Private lighting on a considerable scale was undertaken in the course of the year by several London central station companies; but the largest and most ambitious of all—the London Electric Supply Corporation—having shifted their generating plant from the Grosvenor Gallery to Deptford, met with a misfortune in December in the destruction of the distributing plant and buildings of the former station by fire, which resulted in the total suspension of the service. Some other Metropolitan Companies also gave dissatisfaction to their customers by defective service during the dark days. On the whole, it can hardly be said that the technology of electric lighting was noticeably advanced last year. Neither in lamps, dynamos, nor batteries was there any remarkable improvement; and none of the electrical supply companies in existence held out any hopes of being able to reduce the cost of current below 8d., or, at the very lowest, 7d. per Board of Trade unit, at which rates electric lighting is equivalent in cost to the consumer to ordinary coal gas at 8s. 8d. and 7s. 7d. per 1000 cubic feet respectively. The hopelessness of obtaining a supply from a central station at a reasonable figure favoured the trade in private lighting plants driven by steam or gas engines for business establishments large enough to support installations of the kind. At no previous time has this branch of electric lighting engineering been busier; thus contradicting the prophecies of those electricians who, before the Electric Lighting Act, 1882, was amended, maintained that the public would not have cheap electric lighting until central station companies were generally set up throughout the country. It now appears that the cheapest electric lighting is that obtained from private installations developing (say) from 50 to 100 indicated horse power. There is no prospect of this kind of lighting being supplied anywhere at smaller cost than by such plants; so that it is possible to say now that the fundamental data bearing upon the competition of electric lighting with gas are common property.

Of accidents and fatalities in connection with the coal gas industry, the year was happily barren. The most serious occurrence of the kind, which involved the death of one man, took place at the Middlesbrough Gas-Works in November; the circumstances being fully reported in the JOURNAL at the time. A troublesome mishap befell The Gaslight and Coke Company in connection with the firing, on the Metropolitan Railway, of a naphtha store, which happened to be situated underneath one of their mains. The joints of the main exposed to the heat were started, and the escaped gas ignited and contributed to the general trouble. The circumstances were extraordinary, however, for it must be conceded that not many oil-storeage sheds, actually in the open air, are at the same time placed vertically below a street gas-main. Uncarburetted and inodorous water gas, manufactured at the Leeds Forge works, escaped into a workmen's cabin, and killed two men. This mischief was only in accordance with the ancient reputation of water gas; but it happened at an exceedingly awkward time for Mr. Samson Fox and certain other enthusiastic partisans of water gas, who had been declaring in public that the compound has been maligned in this respect.

Our obituary notices for the year have been few, and do not include many names eminent in the gas industry. Mr. Alfred Penny and Mr. H. P. Stephenson were well-known and respected consulting gas engineers in their day; and they went to their graves full of years and not without honour. Mr. W. Mann was a fine type of the old-fashioned gas manager. The ranks of retired gas directors, aldermen remembered in connection with gas committees, and public characters more or less identified with the history of gas lighting, always furnish a quota of names for our list of deaths; and many such will be found scattered through our two last volumes.

And now nothing remains but to bid farewell to the dying year, and turn hopefully to the New Year which dawns within a few hours. We can see, after running over its salient events as concerning the gas industry of the United Kingdom, that matters might have been worse in it. The greatest danger of all—of triumphant rebellion in the ranks of labour—was quelled with greater ease than some timid and incompetent folks hoped for; and if the Socialistic Millennium is not perceptibly nearer than it was a twelvemonth ago, the reign of Anarchy has been equally set back. Meanwhile, steady progress has characterized the *technique* of the gas industry; and anyone who will look over the JOURNAL for 1890 will see that the literature of gas engineering has been enlarged during this period by many valuable additions. The keynotes of the improved gas engineering of the year that is now closing and for that which is to come are—first, Labour Saving; and, secondly, Cheap Carburetting. We claim that the JOURNAL has done its share in the furthering of these movements, and of all others that are calculated to benefit the gas industry and the community which it serves. We stand in the old ways, and do not run eagerly after new lights. It has never been our faith that the public for whom we provide special reading like weak personalities and the cultivation of sectional enmities rather than independent criticism, comprehensive sympathies, and the suggestion of subjects profitable for reflection. Trivialities hardly suitable for the most worthless catch-penny newspapers are sometimes made to pass for technical journalism, by being hung upon names known in professional life; but if this is fit matter for a technical journal, it must be sought for elsewhere than in these columns. There must, it may well be supposed, be all sorts of journals and newspapers (although it is sometimes hard to admit the necessity), just as there are all sorts of people in the world to write and read them. Our idea of the duty of a technical journal is that it should contain all and every kind of information bearing upon the subjects to which it is devoted, together with original comments, statements, and criticisms from competent authorities on the topics dealt with. This is the standard to which the JOURNAL has always endeavoured to conform through good and evil repute; and to this it will adhere in the future. Then, as the gas industry prospers and extends, our pages will expand with it; and its vitality will be manifested in the continual growth of our half-yearly volumes in bulk and interest.

The Electric Lighting Scheme for Brussels.—We learn that the Municipality of Brussels have resolved not to grant a concession to any company for the electric lighting of that city, but to reserve to themselves the right of carrying it out. This decision is said to have been arrived at owing to the heavy conditions under which the city would have to buy up the plant at the termination of the 25 years' concession. Under these circumstances, the firms who have tendered will have again had their labour for nothing.

WATER AND SANITARY AFFAIRS.

THE past year has been marked by a considerable amount of discussion, and of something like action, with regard to the Water Supply of the Metropolis, and especially as to the position of the Companies by whom the present supply is furnished. Towards the end of January, Professor Stuart, M.P., gave a public address, expounding "The London Programme of the Liberal Members," in the course of which he showed what large profits would have been made, on behalf of the ratepayers, had the undertakings of the London Water Companies been bought up, and made public property, at some previous date. Now at last, in the opinion of Professor Stuart, the proper authority had been established, to whom the momentous duty of controlling—or, in other words, possessing—the water supply of London should be confided. In this way, as was foreseen from the outset, the creation of the London County Council by the Local Government Act of 1888, has given renewed impetus to the demand for placing the Metropolitan Water Supply in the hands of a public authority; the Council being put forward by its friends and admirers as directly adapted for such a purpose. Yet, if the Government and the Legislature really contemplated putting the County Council in possession of the water supply, it seems somewhat strange that the Act which brought the Council into existence did not provide that this new Metropolitan Authority should have power to promote a Bill in Parliament for the purchase of the existing water undertakings, or, as an alternative, the introduction of an entirely independent supply. The Government were so far from doing this that, when they took charge of the Money Bill of the County Council in 1889, they dropped the clause authorizing expenditure by that body for the purpose of an inquiry concerning the water supply of London. In the recent session, the County Council succeeded in getting Parliament to pass their General Powers Bill, containing a clause making it lawful for the Council to expend £5000 in conducting inquiries and negotiations relative to the supply of water, or the Companies furnishing such supply. But the ancient Corporation of the City felt it necessary to be on the alert, and anticipated the action of Parliament by decreeing an expenditure of £2000 out of the civic funds, for the purpose of conducting a water inquiry of their own. With yet further adroitness, the Corporation asked the President of the Local Government Board to name an expert who could preside over the inquiry. Mr. Ritchie cautiously declined the function thus assigned to him; and the Corporation proceeded to elect Sir W. Guyer Hunter, M.P., to the post of Chairman in connection with the Water Inquiry Committee—the London Water Companies being severally invited to send an official representative to give evidence on their behalf before this improvised tribunal. The answer returned in each instance to this latter proposal was similar to that expressed in the reply from the Directors of the West Middlesex Company, who said they did not see the advantage of offering any evidence before a body of gentlemen who were conducting an entirely irresponsible inquiry. As might have been expected under the circumstances, some rather strange evidence was given before the Corporation Committee, though a few of the witnesses furnished useful information, as in the case of Major Lamorock Flower, Mr. Samuel Wood, and, in part, Sir Robert Rawlinson. The evidence of Mr. Jabez Hogg and Mr. Archibald Dobbs we challenged at the time. At last, after holding thirteen sittings, and calling thirty-seven witnesses, the Corporation Committee finally presented their report; one leading feature consisting in a recognition of the districts outside the Metropolitan boundary, as interested in the water supply furnished by the London Companies. Coupling the outer area with the inner, the Committee recommended the introduction of a Bill into Parliament, providing for the creation of a Water Commission, on which all the authorities interested in the matter should be represented; such Commission to have power to introduce an independent supply, or to purchase the waterworks already existing.

A Bill, in accordance with the recommendations of the Corporation Committee, has been duly lodged, and it is to be brought forward in the ensuing session. Its provisions have already been discussed in our columns; and while it exhibits some degree of moderation—taking a broader view than other projects which have been aired on this question—the scheme yet contains proposals to which the Companies cannot possibly assent. As for the County Council, they seem to have done very little with the £5000 placed at their disposal. One result is a report on the water supply of London by their Engineer (Mr. A. R. Binnie), which report has not yet been given to the public, though a little of it has been revealed by Sir Thomas Farrer. Concerning the inquiry which the Council were going to undertake, this has been upset by some difficulty in getting the Companies to attend. On this point there need have been no difficulty, had the Committee gone to work in the right way. The Companies recognized the position of the County Council as authorized by Parliament to conduct an inquiry, and drew a distinction in favour of that body as compared with the Corporation. Yet we find the idea of an inquiry abandoned by the Council, on the plea that the Companies "were unanimous "in declining to submit evidence at such inquiry." This statement is hardly fair to the Companies; seeing that their objection was to the request that they should name a price for their undertakings. As the Council had no power to purchase, or even to introduce a Bill for the purpose, the Companies would naturally feel that to name a price would simply place them in a position inviting attack, without any counterbalancing advantage. To stand up to be shot at was not exactly what they had a right to expect. The County Council were equally unlucky, or awkward, in their approaches to the Corporation; and while professedly seeking a conference, never managed to make the requisite arrangements. All that the Council can now do is to prepare for opposing such Bills as come before Parliament in relation to the water supply of London. There is, or will be, one notable Bill to which they may be supposed to have a kindly leaning, though it is not in all points favourable to their pretensions. This is the Bill promoted by the Vestries, proposing, among other things, to transfer the water supply to the County Council or to a Water Trust. As the Vestries have no *locus standi* in Parliament, it is not clear how this Bill is to proceed, except on the supposition that the Government will take it in hand. The foundation for this hope consists in a remark or two made by Mr. Ritchie in receiving a deputation of Vestry delegates organized by Mr. James Beal. We have recently given reasons for the belief that the Government are not likely to undertake the Vestry Bill, or any other measure at present, dealing with the subject of the London Water Supply. In addition to these schemes, there is a London Water Bill, already past the first reading, and also a Bill by Mr. Causton, which has reached the same stage. The former measure is to give the consumer the option of having his supply by meter; while the latter is to prevent the Companies from raising their charge *pro ratâ* with the assessment. Of course, the water-rate is to remain tied to the assessment when the latter falls, of which there are likely to be numerous examples next April. The attitude of the Government on the valuation question may be inferred from the reply given by the President of the Local Government Board to Mr. J. Kelly in the House of Commons last May, when Mr. Ritchie stated that the power of charging according to the rateable value was conferred on the Water Companies by statute, and could not—so he considered—be dealt with alone. The matter, Mr. Ritchie signified, was one which should be regarded in connection with the whole question of water supply. Mr. Kelly, and others with him, will see what this means when the water supply of London passes into the hands of a public authority.

Some important facts connected with this subject were opportunely set forth by the Metropolitan Water Examiner, General A. de C. Scott, in one of his monthly reports last summer. It was shown that more than 1,100,000 persons living outside the Metropolitan area were supplied with water by the London Water Companies, and that the areas of supply outside the Metropolis have more than three times the extent of the intra-Metropolitan area. The entire population served by the Companies at the termination of last year amounted to 5,624,000, distributed over an area of 519 square miles. As the case now stands, supposing the London Water Supply to be transferred to the London County Council, without any alteration in the constitution of that body, the population extending over an area of practically 400 square miles would have no voice in the Council, and no control over the administration of their water supply;

the circumstance being all the more anomalous, seeing that the source of the supply is found in the outer area. In reference to the purity of the water distributed by the Companies, we here observe that the general tenor of Dr. Frankland's reports during the past year has been eminently satisfactory; the water supplied both from the Thames and the Lea being frequently mentioned as exhibiting a high degree of organic purity.

Concerning the water supply of the provinces, there is not much to be said, though steady work is being done, and further improvements are about to take place. The expenditure of the Liverpool Corporation on their great Vyrnwy works now exceeds £2,000,000. During the past session, the Corporation of Bradford carried their Bill through Parliament, giving them power to raise £1,230,000 in order to extend the water-works of the town. Storeage and compensation reservoirs on a large scale are to be constructed in the watershed of the Nidd. The Derby Corporation obtained an Act for raising £200,000, in order to construct new works, and extend the water supply to a larger area. The Huddersfield Corporation were authorized to purchase the water undertaking of the Wessenden Commissioners, and to construct additional works. An Act obtained by the Leicester Corporation extends the limits of supply, and provides for raising £320,000 for a new reservoir and other appliances. The Morley Corporation in like manner obtained power to borrow £100,000, for the purpose of constructing an impounding reservoir, the supply from which is to be laid on constantly under pressure. At Stockton and Middlesbrough we find parliamentary power given to construct new works, and to enlarge the supply temporarily taken from the River Tees. Large towns, with a rapidly increasing population, are naturally compelled to extend their works of water supply, and to raise additional capital for the purpose. But the necessity for giving a proper water supply is sometimes no less urgent, though on a smaller scale, in the rural districts.

The sewage question has presented nothing of a very novel or striking character during the year. The report by Sir B. Baker and Mr. A. R. Binnie, on the disposal of the sewage of London, has not yet been laid before the County Council; and what course these Engineers will advise is, as yet, a matter of conjecture. But whatever may be designed in the future, it would seem wise to make use of the means at hand, especially when three-quarters of a million sterling have been expended on the existing plan. The precipitation works at the Crossness outfall are still unfinished; chiefly owing to the absence of the requisite machinery. At Barking the sewage works are not yet in complete operation; but a considerable quantity of sludge is being daily carried off by the specially-constructed sludge ships to the North Sea. Mr. Webster's electrical process for the treatment of sewage has been on trial at Salford; and the results are awaited with interest. Various processes for the purification of sewage are now in operation in different parts of the kingdom; and, on the whole, something is being done to prevent that reckless pollution of streams which formerly prevailed.

Coal Dust and Explosions in Mines.—The Home Secretary has just issued to the Inspector of Mines a minute in reference to the effect of the presence of coal dust in propagating explosions. Owing to the occurrence of two disastrous explosions in the course of the present year (those at the Llanerch and Morfa Collieries), fresh prominence has been given to this question. Both of these explosions were made the subject of careful investigation by competent men. But, although various theories were advanced in order to account for their origin and course by the presence of gas, they were not by any means conclusive; and there were many circumstances which led to the inference that one or both of the explosions were extended and assisted, if they were not caused, by coal dust. As the Home Secretary felt the great importance of arriving at further information and more certain conclusions on this subject, he sanctioned the proposal of Mr. Hall, the Inspector of Mines, to conduct experiments for the purpose of ascertaining whether an explosion can be caused by blasting operations when coal dust is present, and in the entire absence of gas or fire-damp. The result of his experiments is that a blown-out shot may, in the presence of coal dust, and in the entire absence of fire-damp, cause explosions of considerable violence, often accompanied by volumes of rushing flame, travelling very great distances, and possibly so far as the supply of coal dust continues. Mr. Matthews states that these experiments do not by any means exhaust the field of inquiry which he proposes to pursue, with the best scientific assistance he can obtain.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1332.)

THE past week's operations on the Stock Exchange were naturally very limited. Even the first three days furnished but little business; Thursday and Friday were close holidays; and on Saturday the place would have been pretty well deserted but for the necessity of commencing the settlement that day. Prices have moved the slightest degree up and down; but there is no marked tendency either way. After the recent exciting times we have gone through, a period of all but inaction comes as a relief, during which we can indulge in looking forward to that good time which 1891 is said to promise. At home, trade prospects are generally promising, and—despite the Scotch railway strike—relations between employers and employed in general are much more harmonious than they were this time twelvemonth. Abroad, that terribly uncertain element, the peace of Europe, really appears more than usually well assured; and although it needs but a spark to set all ablaze, there is not a glimmer of one to be seen just now. The course of the Money Market, which depends upon so many factors, is always difficult to foresee with any degree of certainty; but the probabilities are all in favour of cheaper money. In a few weeks we may have a good, sound, and durable 4 per cent. rate. What will 1891 do for Gas? We know that the Gas Companies are doing good steady business; that the application of gas to purposes other than illumination has attained a proportion which, if prognosticated two or three years ago, would have been regarded as wildly extravagant; that the stove-business is rapidly becoming a highly-important and profitable department, and is progressing by giant strides. But, on the other hand, it must be borne in mind that the figures on the expenditure side of the Companies' accounts will be very largely increased by the higher rates of wages paid and the greatly enhanced price of coal. It must, therefore, not be expected that companies which have for years past regularly earned their 10 per cent. dividend and upwards, will show in their next accounts earnings at all approaching such a rate; and they will either have to be content to distribute a lower dividend, or they will have to draw largely upon their reserve funds (if they have any), in order to maintain their previous rates. But this need cause no alarm. The gas industry, like others, must have its good and bad seasons. It has had a long run of good ones; buying coal at cruel prices for the coal-owners. They now are having their good turn. But the latest gas-coal contract prices are not going to last for ever; and we shall see coal down again. The prices of Gas securities may, therefore, be subject to some variation in the coming year; but their soundness and permanent stability as an investment should remain untouched.

It is unnecessary to notice in detail the very few operations in Gas and Water stocks which were effected during the past week. The prolonged wintry weather has been favourable to the former; and gas companies have been doing a large business this December. The only changes in the quotations are a rise of 1 in Gaslight "A;" 1 in ditto "J;" and 2 in ditto "C," "D," and "E."

ELECTRIC LIGHTING MEMORANDA.

The Difficulties of the Electric Lighting Companies—The Board of Trade Commission on Electrical Standards—Professor Nichols on Incandescent Lamps—The Price of Platinum.

THE difficulties of the central station lighting companies are the theme of animated discussion in the electrical press. The London Electric Supply Corporation, whose failure to justify their name has led some of their customers to write angry letters to the newspapers, seem to have been in deeper trouble than they cared to confess. Their disastrous fire at the Grosvenor Gallery station was followed by a breakdown of the partially-repaired transformers, according to the *Electrical Review*, the consequence of which was a stoppage of supply to all their customers. It is stated that the Company had actually to shut down all work and undertake general repairs. This, seeing that they have never yet fully started their plant, ought to make the friends of the high-pressure alternating-transformer system of supply think twice before committing themselves to it beyond power of recall. What has really been going on inside the Deptford concern, will probably never be known. The Engineer (Mr. S. Z. de Ferranti) holds his head very high, and will not admit that there can be anything radically wrong with his plans. The *Electrical Review*, however, implores him to take advantage of the suspension of lighting by the Company to thoroughly reconsider his arrangements, which is inviting him to confess that he has made a monumental blunder and wasted an enormous amount of his employers' money—a thing which, of course, he is not in the least likely to do. Our electrical contemporary admits that "a failure, or even a partial stoppage of the Deptford works, would be disasterous to the electric lighting industry." This is so far true, that we are quite justified in asserting even now that the failures of electric lighting which have annoyed the Metropolitan patrons of the supply companies during the bad weather of the past three weeks, have had a serious effect upon the prospects of these undertakings. Public

confidence has been rudely shaken; and it will be some time before it can be re-established, if ever.

It was announced last week that the Board of Trade had appointed a Committee, which included several well-known names of authorities on physical science, to consider the question of the establishment of an electrical standardizing laboratory. This is an accommodation that has been asked for by electricians for some time; and it will of necessity be provided if electric lighting prospers as an open industry. The demand comes in the first place from the electric lighting companies. These undertakings have no control over the incandescent lamps purchased by their customers; and they fear that with the expiration of the Swan patent, the market will be flooded with cheap imitations of the standard lamps, which will take more current to give their rated illuminating power than it will be at all profitable to the companies to supply. The lighting companies are naturally interested in their customers employing the most economical lamps; but the latter are more interested in getting cheap and durable lamps. If no lamps are allowed to be sold that do not satisfy a certain standard, the companies say they will be quite content. There being obviously two sides to the question, however, the Board of Trade are having it inquired into independently before taking the action demanded of them.

Some light is thrown upon the previous subject by a lecture delivered by Professor Edward L. Nichols before the New York Electric Club. The lecturer stated that the condition of the incandescent lamp of to-day affords an electrician little reason for congratulation. It is true, he admits, that the efficiency of the modern lamp has risen from 5 to 3 watts per candle, "but those who have had occasion to trace the discouraging life-curves of such lamps, know how little real progress the change implies." The efficiency of the so-called improved modern lamp is possibly high to begin with; but it is only a question of a few days or hours when the lamp will have dropped to the old 5-watt level, which seems to "mark the confines of permanency" in the case of incandescent carbon. Professor Nichols asserts from his own experience and that of other observers, that if a 16-candle power lamp is supplied at a constant potential, its consumption may be only a fraction over 3 watts per candle at starting; but it rapidly loses 50 per cent. of this efficiency. So treated, the lamp may last 800 hours. If the pressure is increased as the efficiency of the carbon falls, so as to get the same work out of it, the lamp breaks down in 100 hours. Professor Nichols concludes that an incandescent lamp in which carbon is the material of the filament is "fairly stable only at temperatures for which its efficiency does not exceed about 5 watts per candle."

A matter that is agitating the minds of electricians is the remarkable rise in the value of platinum. A year ago this indispensable metal for the physicist and chemist was worth about 30s. per ounce; it now fetches 60s., and has a marked upward tendency. In a little time it is expected to equal the price of gold. There was a time, not so very long ago, when in Russia the metal was unsaleable at 17s. per ounce. It is well known that the Russian Government tried to steady its value by coining it into money; but the experiment failed, because the people exported the coinage when the metal became dear, and would not take it when it was low priced. Platinum is largely used in electric lighting apparatus; and its scarcity will certainly not facilitate the desire of electricians to cheapen their commodity.

Utilizing the Falls of Niagara.—The International Commission, of which Sir W. Thomson is the President, will, says *Industries*, be able to commence its work on the 1st prox., before which date all plans for the carrying out of this project are to be sent in. The Commission drew up the following outline according to which plans were to be prepared: (*a*) For hydraulic projects for the primary development of power by turbines or water motors; (*b*) projects for the transmission and distribution of power from the primary; (*c*) projects combining both the development and transmission combined. As this is essentially an American enterprise, all communications are to be in the English language, and the dimensions of plans and all calculations to be expressed in English measures, and the financial statements in dollars at the rate of 5 frs. per $1, and $5 per £1 sterling. Projects have been invited for one central station, located at the head of the tunnel, for: (1) The economical development of as much power as the section of tunnel, the head of water, and the hydraulic slope will permit; and (2) the transmission and distribution of this power overhead, underground, by electricity, compressed air, water, cable, or other means in a manufacturing district to be built up within a radius of four miles, and to the city of Buffalo, a distance about 20 miles. It is suggested that the central station should be so designed that a combination of methods of transmission and distribution may be employed, according to the probable demand therefor by the various classes of industries; that a block of 50,000-horse power may be specially designed for the Buffalo transmission; and that the entire capacity of the tunnel may be developed gradually in blocks of from 10,000 to 20,000-horse power each. The methods of transmission or distribution should be those best suited to large manufacturing cities, requiring (1) electricity for domestic, street, and manufacturing purposes; (2) water for power, domestic, fire, and manufacturing uses; and (3) air for power, ventilating, and refrigerating, and many uses to which it lends itself.

THE EFFICIENCY OF ARTIFICIAL LIGHTING.

When one comes across a paper or a lecture by a Professor of Physical Science entitled "The Light of the Future," it might be supposed that little more explanation of the nature of the subject-matter is needed. Electricians have so long claimed the Future for their own, that the community in general, and gas engineers in particular, have resigned it to them, content to witness the apparent difficulty of converting this Future into an actual Present. So long as the Happy Future of the electricians peristently removes itself when pursued, like the rainbow, it would be cruel to deny them the barren enjoyment of claiming possession of it. When, therefore, anybody of a scientific turn has spoken of a Light of the Future during the past ten years, he has been understood to refer to electric lighting. It consequently comes with something of a shock to learn that the very latest public references to the artificial lighting of the world in the future time are no longer complimentary to electricians and their methods—that already, in the eye of the true *fin du siècle* philosopher, electricity as a means of lighting has found its limitations, and that for something really and scientifically satisfactory we must look very far beyond the incandescent or the arc lamp! There is something very startling about this proposition; and it will therefore be an appropriate exercise for this season of fairy tales, if we examine the foundations of this, the newest of the fairy tales of science.

Two authorities are responsible for thus publishing the imperfection of electric lighting before it has really entered into the restricted inheritance that may be supposed to be reserved for it in the world—Mr. T. A. Edison and Professor E. L. Nichols. Mr. Edison declares that, in order for electricity to become a truly cheap and efficient servant of mankind, it must be derivable directly from the combustion of coal, without requiring, as at present, the intermediary of steam. This statement, to the intelligence of the engineer, covers a very large order. Such a man cannot conceive how the fundamental change spoken of by Mr. Edison can be brought about; but the mechanic mind cannot grasp everything. Mr. Edison acutely says that it is scarcely conceivable to us how the highly civilized and reflective minds of the Greek and Roman period in the world's history missed the knowledge of electricity and other natural forces, which seem to have obtruded their phenomena upon the observant spirits of the modern era. They had the same hints from Nature that we have; yet they never heeded or questioned them. Similarly he believes that our posterity may see meanings in the things of Nature that we cannot distinguish, and may wonder at the narrowness of our perceptions. That such a pre-eminently practical man as Edison should talk in this way, and be content to attach the eventual triumph of electricity to a condition which appears to us a dream, is at least a steadying thought for the hare-brained folk who would persuade the world that the reign of electricity has already begun.

After Edison comes Nichols, who tackles the problem from the other end, and, without inquiring about the possibility of doing away with steam, reminds electricians of the limitations of their power in the matter of lighting. If Edison's dream were to be realized to-morrow, Nichols's criticism would still hold good. He declares that, although carbon is the best material that electricians have yet found to work with, both for incandescent and arc lighting, yet it is essentialy defective for either use. He absolutely denies the validity of the claims that have of late been made for an increase of the duty obtainable from incandescent lamps; declaring that these only hold good at the very outset of a lamp's service. After a time, if the lamp filament is to stand the strain of incandescence for any reasonable period, judged from commercial considerations, its efficiency must fall to the dead level of 5 watts per candle, which is no better than the performance of the earliest successful lamps. This result is not ascribable, according to Professor Nichols, to any fault in manufacture, but to the very nature of the material itself. To get a higher duty out of a carbon filament means increasing its temperature. Professor Nichols asserts upon this point that "the temperature of an incandescent lamp filament at 5 watts per candle is very nearly the same as that of the carbon in the light-giving flames produced by the combustion of oils and gas; and it appears that the attempt to pass this temperature introduces difficulties of such a nature as to lead to the serious question whether we have not reached a definite limit, beyond which incandescent carbon ceases to be permanent. At that limit the efficiency of the lamp is very small indeed; 95 per cent. or more of the radiant energy emitted being of wavelengths too long to afford light." This is a weighty statement, which requires to be pondered over. If it is true—and the authority is good enough to warrant us in accepting it as a fair deduction from proofs—the incandescent electric lamp has already found its limit of efficiency, which is a very low one. There is a good deal in the idea that, whether carbon is rendered incandescent in a gas-flame or in a filament subjected to an electrical current, it will only stand luminous up to a certain maximum temperature. The same remark holds good of the carbon rods used for arc lamps. Professor Nichols declares that the quality of arc lighting, instead of being improved by the new apparatus, has positively fallen off from the standard of the old-fashioned clockwork regulators of Dubosc and Foucault. On the whole, therefore, this authority concludes that it is "only too

probable that the limiting temperature at which carbon can be used for the production of light has been reached, and with it the maximum efficiency of artificial illumination." This is the most downwright, as well as one of the most plausible pronouncements on the limits of the capabilities of the artificial lighting agents ordinarily in use, that we have ever come across. It will be seen that, arguing from incandescent electric lamps, Professor Nichols commits himself to the statement not merely that these are as perfect as they can possibly be while carbon is the incandescing material, but also that the carbon in gas-flames is actually bearing as high a heat, and therefore doing as much duty, as its nature permits. The importance of this consideration cannot be over-rated.

If carbon, the universal illuminating agent of the world, is strained to its limits in lights which, after all, waste 95 per cent. of their radiant energy in invisible waves below the red end of the spectrum, are we likely to do better with anything else, either in substitution for, or in association with it? Professor Nichols frankly admits that he does not know. "In the vast accumulation of experience which the past years have witnessed, nothing has come to general knowledge which looks to the raising of the barrier which blocks our progress." This is speaking in the practical sense. Abandoning the immediate practical issue, however, there is something to be said. If we have come to the end of our tether with carbon, we can at least point to wider efficiencies disclosed by lighting media of non-human devising. And we know of a large number of elements and compounds that are capable of sustaining higher temperatures than carbon without dissociating or changing state. Carbon is the only refractory element, says Professor Nichols, the capabilities of which as a source of light can be said to have been fully tested; yet all the others emit light when heated to the proper point. Take, for example, the metallic oxides, such as the oxide of calcium which is used with such effect, albeit so clumsily, in magic lanterns. Magnesium, again, gives a truly wonderful light, although we find it at present both costly and unmanageable. Yet the element is one of the most abundant constituents of the earth's crust, if we could only separate and reduce it easily. Among artificial illuminants, magnesium has in one respect no equal. Ten years ago it was found by Pickering to approach sunlight in quality. Weight for weight, magnesium gives more than thirty times the light of coal gas, with much less development of heat. Such is its quality, that its light must be valued higher than the same amount of any other artificial light.

The problem of the superior lighting of the future is stated by Professor Nichols as follows: (1) We need a body which is rendered vividly luminescent by heat; and the metallic oxides would seem to offer us many such. (2) The material is to be brought to the temperature at which its luminescence is most marked. (3) The material must be restored from time to time. These conditions may manifestly be satisfied in a variety of ways. Thus the heat may be that of combustion or of an electric current, and the reparation may be electrical, chemical, actinic, or mechanical. Luminescence by heat offers, however, only a partial solution of the problem. Incandescence is too costly an accompaniment of luminescence to be preferred if the latter effect can be attained by other means. It can, as a matter of fact, be generated by "friction, chemical action, the impact of light-waves, and certain vital processes." The physics of these phenomena is for the most part undeveloped. Only two attempts are known to have been made to ascertain the efficiency of these so-called "lights without heat." The light is, as a rule, not very brilliant; and the accompanying heat is beyond the scope of all but the most delicate of apparatus. Yet that there should be any light at all is the main consideration. Professor Langley and Mr. F. W. Very, in a recent paper on the cheapest form of light, do not refer to that of the spark discharge *in vacuo*, well known from lecture experiments with Geissler tubes, which is attended by a very small development of heat, but to the light of certain self-luminous insects, which has already been mentioned in the JOURNAL. All the energy of the spectrum of this insect-light is massed within the visible spectrum, and in its most efficient portion. Altogether, while showing that the efficiency of all present known lights is too low to meet the demands of the future for economical illuminations, Professor Nichols holds there are many other sources of light which promise high efficiency.

Illness of Mr. Thornton Andrews.—We regret to learn that Mr. Thornton Andrews, M. Inst. C.E., Engineer and Secretary of the Swansea Gas Company, is seriously ill in consequence of the rupture of a blood-vessel.

The Bradford Water-Works Engineership.—At their meeting last Tuesday, the Bradford Corporation Water Committee decided to recommend the Town Council to appoint Mr. James Watson, M. Inst. C.E., as the new Water-Works Engineer, at a salary of £1000 per annum. Mr. Watson, who is forty-seven years of age, has for nearly nineteen years held the office of Water Engineer to the Dundee Corporation; and during the three previous years (1869-71), he was Chief Assistant in the office of the Borough Engineer of Dundee. Mr. Watson was selected from 61 candidates for the post, which, it will be remembered, was formerly held by Mr. A. R. Binnie, who relinquished it to take the office of Engineer to the London County Council,

NOTES.

Selenium for Commercial Uses.

Up to the present time very little use has been made of the remarkable property of selenium in changing its electrial conductivity upon exposure to light. Attempts made to utilize this phenomenon in the construction of a photometer have not had any permanent success. At a recent meeting of the Physical Society, Mr. Shelford Bidwell read a very interesting paper on selenium, and exhibited a selenium cell controlling an electrical relay which could be adapted to a variety of purposes. In one arrangement, it was made to work an automatic watch-light; turning on a little lamp on the approach of darkness, and extinguishing it again at dawn of day. By another arrangement the cell could be used to give notice if a railway signal-light or a ship's side lantern should happen to go out. A fire-alarm could be made by the same means; only the warning would in this case be given by light instead of heat, which would make it rather late to be of much service. It seems possible that at this rate an application of selenium may be made to a sort of tell-tale photometer, which should ring a bell whenever the illuminating power of the flame fell below a certain point.

The Synthesis of Ammonia.

Statements are occasionally published respecting the possible direct synthesis of nitrogenous compounds, such as cyanogen and ammonia, from the direct action of the air upon certain materials; and some such action is very commonly imagined to go on in coal-gas retorts. A series of experiments upon the synthesis of cyanogen compounds by the mutual action of charcoal, gaseous nitrogen, and alkaline oxides or carbonates, at high temperatures and under great pressure, are described by Professor Hempel in the current number of the *Berichte*. It was demonstrated long ago, by Bunsen and Playfair, that when charcoal and potassium carbonate are heated to redness in an atmosphere of nitrogen, a certain quantity of cyanide of potassium is formed. Since that time Margueritte and Sourdeval have further shown that barium carbonate may be used instead of the potash, and that the barium cyanide produced may be again decomposed by steam into ammonia and barium carbonate. Theoretically, these reactions afford a continuous process for the conversion of atmospheric nitrogen into ammonia—a process which, if it could only be worked on a large scale commercially, would doubtless be of immense value. Unfortunately, only small proportions of the substances employed appear to enter into the reaction at ordinary pressures; hence the yield is insufficient to render the process economical. Professor Hempel has now shown, by means of a simple pressure apparatus, that the reaction is very much more complete, and, when potash is used, very energetic, under a pressure attaining 60 atmospheres. His apparatus consists of a solid steel cylinder closed at one end, and stopped with a screw at the other. A connection is made by a pipe from a pressure-pump; and a carbon electrode also enters, and is plunged into a mixture of carbon and the alkaline oxide or carbonate. The electrode is made red hot, and nitrogen is forced in until the desired pressure is obtained. This process is not, of course, commercial; but it indicates an advance in the actual synthesis of ammonia compounds.

The Direct Conversion of Heat into Electricity.

Mr. Edison is reported to be engaged, among otherthings, in an attempt to discover a means of obtaining electrical energy direct from coal. He asserts that he has made some little headway in this direction; but although he can obtain a small quantity of electricity directly from fuel, it has no force to speak of, and is not the true power for which he is seeking. He admits that until this revolutionizing discovery is made, electricity must continue to be heavily handicapped as a means of lighting and for motive power. Electrical apparatus and lamps are fairly efficient already; but it is the necessity of having to employ steam machinery to actuate them, that entails so much waste. Electricity will never deserve to be classed as a motive power until it can be derived directly from the combustion of fuel, which Mr. Edison professes to believe possible. In this event, steam would become a thing of the past, and electricity would be universally used. Instead of only about 15 per cent. of the intrinsic value of coal being utilized, nearly all of it would be converted into power; and the result would be to postpone the exhaustion of the coal-fields. Mr. Edison says he is hopeful that the problem will be solved; but perhaps not by himself. Yet he continues working at it; and though it may be years before he arrives a step nearer the solution, it may with equal probability come at any moment. Nevertheless, he believes that gas will always continue to be made, if only for fuel.

Death of Mrs. Eldridge.—We regret to record the death, on the 19th inst., at the residence of her son, in Oxford, of Mrs. Charlotte Eldridge, widow of the late Mr. James Eldridge, for many years Engineer of the Richmond Gas Company.

Mr. Young's Paper on "Standard Sperm Candles."—In the JOURNAL some weeks ago, we announced that Mr. W. C. Young, one of the Gas Examiners for the Metropolis, would read a paper, on "Standard Sperm Candles," before the London Section of the Society of Chemical Industry on the 5th prox. We are asked to mention that the paper has been postponed to the 2nd of February.

TECHNICAL RECORD.

GASEOUS ILLUMINANTS.

The last of the series of the Cantor Lectures on the above subject was given at the Society of Arts by Professor VIVIAN B. LEWES, F.I.C., F.C.S., on Monday evening last week; the matters discoursed upon being the combustion of coal gas and the probable future of gaseous illuminants and heating gases.

The lecturer commenced by saying that, having brought before his audience the various methods by which ordinary coal gas can be enriched, so as to give an increased luminosity to the flame, he wished to discuss the methods by which it can be burnt in order to yield the greatest amount of light, and the products which result during combustion. He then went on to remark that in the first lecture, while discussing the theory of luminous flames, he pointed out that in an atmospheric burner it was not the oxygen of the air introduced combining with and burning up the hydrocarbons, and so preventing the separation of incandescent carbon, which produced a non-luminous flame, but the diluting action of the nitrogen, which acted by cooling the flame; thus preventing a temperature being reached at which the hydrocarbons are broken up, and the carbon liberated—a fact which was proved by his showing that heating the mixture of gas and air again restored the luminosity of the flame. This experiment clearly showed that temperature is a most important factor in the illuminating value of a flame; and this is still further shown by a study of the action of the diluents present in coal gas—the non-combustible ones being far more deleterious than the combustible, as it is found that they not only dilute, but withdraw heat. Anything that will increase the temperature of the flame will also increase the illuminating power; provided, of course, that the increase of temperature is not obtained at the expense of the too rapid combustion of the hydrocarbons, as was shown by experiment when studying the action of diluents on flame. Oxygen added to coal gas increases its illuminating value to a marked and increasing degree until a certain percentage has been added; after which the illuminating power is rapidly decreased, until the point is reached when the mixture becomes explosive. This is due to the fact that the added oxygen increases the temperature of the flame by doing the work of the air, but without the cooling and diluting action of the nitrogen. When, however, a larger proportion is added, it begins to burn up the heavy hydrocarbons: and although the temperature goes on increasing, the light-giving power is rapidly lowered by the diminution of the amount of free carbon in the flame.

It has been proposed to carburet and enrich poor coal gas by admixture with it of an oxy-oil gas made under Tatham's patents, in which crude oils are cracked at a comparatively low temperature, and are then mixed with from 12 to 24 per cent. of oxygen gas. Oil gas made at low temperature is *per se* of little use as an illuminant, as it burns with a smoky flame, and does not travel well; but, when mixed with a certain amount of oxygen, it gives a very brilliant white light and no smoke, while, as far as experiments have at present gone, its travelling powers are much improved. At first sight it seems a dangerous experiment to mix a heavy hydrocarbon gas with oxygen; but it must be remembered that, although hydrogen and carbon monoxide only need to be mixed with but half of their own volume of oxygen to produce the most explosive compound, yet as the number of carbon and hydrogen atoms in the combustible gas increases, so does the amount of oxygen needed. So that coal gas requires rather more than its own volume, and ethylene three times its volume, to yield the maximum explosive results; while these mixtures begin to be explosive when 10 per cent. of oxygen is combined with hydrogen or water gas, 30 per cent. with coal gas, and more than 50 per cent. with oil gas of the character used. It is claimed that if this gas were used as an enricher of coal gas, 5 per cent. of it would increase the luminosity of 16-candle gas by about 40 per cent. Oxygen has been obtained for some time past from the air, on a commercial scale, by the Brin process; but it has never been produced so cheaply as to allow of its free use for industrial purposes. At the present time, however, there seems every prospect of our being able to obtain very pure oxygen at a low rate. The process by which this important result is to be obtained is as old as the hills, and was first introduced by Tessié du Motay, and consists of passing alternate currents of steam and air over sodic manganate heated to dull redness in an iron tube. The process has never been commercially successful, for the reason that the contents of the tube fused, and, flowing over the surface of the iron, rapidly destroyed the tubes or retorts; and also, as soon as fusion took place, the mass became so dense that it had little or no action on the air passing over it. Now, however, Mr. Bowman claims that he has overcome this difficulty, by preparing the manganate in such a manner as to entirely prevent fusion, and to keep it in a spongy state, which gives very high results; and the substance being practically everlasting, the cost of production is extremely low. It is proposed to feed this by a separate system of pipes to small gas-jets; and, by converting them into practically oxy-hydrogen blow-pipes, to raise solid masses of refractory material to incandescence, and also, by supplying oxygen in the same way to oil-lamps of particular construction, to obtain a great increase in illuminating power. Whether these methods of employing oxygen will be successful or not I do not wish to discuss at the present time; but there is no doubt that cheap oxygen would be an enormous boon to the gas manager, as, by mixing 5 per cent. of oxygen with his coal gas before purification, he could not only utilize the method so successfully introduced by Mr. Valon at Ramsgate, but could also increase the illuminating value of his gas to a slight extent.

In speaking of the structure of flame, I pointed out that close to the burner from which the gas giving the flame is issuing, a space exists in which no combustion is going on; in other words, a flame is never in contact with the rim of the burner. This is best seen when the gas is turned low. With a batswing burner, for instance, turned so low that only a small non-luminous flame is left, the space between burner and flame will appear as great as the flame itself; while if the gas is mixed with an inert diluent like carbon dioxide, the space can be very much increased. Several theories have been brought forward to explain this phenomenon; but the true one is that the burner abstracts so much heat from the flame at this point that it is unable to burn there. This can be proved by the fact that where a cold object touches the flame, a dividing space similar to that noticed between flame and burner will always be observed; and the colder the object, and the more diluted the gas, the greater is the observed space. If a cold metal wire or rod is held in a non-luminous flame, it causes an extinction of the gas for some considerable space around itself; but, as the temperature of the rod rises, this space becomes smaller and smaller, until the rod is heated to redness, and then the flame comes in contact with the rod. In the same way, if the burner from which the gas is issuing be heated to redness, the space between burner and flame disappears. It has already been shown that, cooling the flame by an inert diluent reduces the illuminating value, and finally renders it non-luminous; and we are now in a position to discuss the points to aim at in the construction of a good gas-burner. In the first place, a sensible diminution in light occurs when a metal burner is employed; and the larger the surface and thickness of the metal, the worse will be its action on the illuminating power of the flame. But this cooling action is only influencing the bottom of the flame. With a small flame, the total effect is very great; with a large flame, almost *nil*. The first point, therefore, to attend to is that the burner should be made of a good non-conductor. In the next place, the flow of the gas must be regulated to the burner; as, if you have a pressure higher than that for which the burner is constructed, you at once obtain a roaring flame and a loss of illuminating power, as the too-rapid rush of gas from the burner causes a mingling of gas and air, and a consequent cooling of the flame, while the form of the flame becomes distorted. The tap also which regulates the flame is better at a distance from the burner than close to it; as any constriction near the burner causes eddies in the flow of the gas which gives an unsteady flame. These general principles govern all burners.

We will now take the ordinary forms in detail. In the flat-flame burner, given a good non-conducting material and a well-regulated gas supply, little more can be done, while burning it in the ordinary way, to increase its luminosity; and it is the large surface of flame exposed to the cooling action of the air which causes this form of burner to give the lowest service of any per cubic foot of gas consumed. Much is done, moreover, by faulty fittings and shades, to reduce the already poor light afforded, because the light-yielding power of the flame largely depends on its having a well-rounded base and broad luminous zone; and when a globe with narrow opening is used with such a flame as is done in ninety-nine cases out of a hundred, the up-draught drags the flame out of shape, and seriously impairs its illuminating power—a trouble which can be overcome by having a globe with an opening at the bottom not less than 4 inches in diameter, and having small shoulders fixed to the burner which draw out the flame and protect the base from the disturbing influence of draughts.

The Argand burner differs from the flat-flame burner in that a circular flame is employed, and the air supply is regulated by a glass of cylindrical form. This kind of burner gives better service than a flat-flame, as not only can the supply of gas and air be better adjusted; but the air being slightly warmed by the hot glass, adds to the temperature of the flame, which is also increased by radiation from the opposite side of the flame itself. The chief loss of light depends upon the fact that, being circular, the light from the inner surface has to pass through the wall of flame; and careful photometric experiments show that the solid particles present in the flame so reduce its transparency that a loss amounting to about 25 per cent. of light takes place during its transmission. The height of flame also must be carefully adjusted to its size; as too long a chimney, by increasing the air supply, unduly cools and so lowers the illuminating power of the flame. Experiments with carburetted water gas gave the following results:—

Size of chimney . .	6 × 1¾ in. ..	7 × 1¾ in. ..	8 × 1¾ in. ..	9 × 1¾ in.
Height of flame . .	2¾ in. ..	2¾ in. ..	2¾ in. ..	1¾ in.
Illum. power (candles)	21·0 ..	21·3 ..	20·8 ..	18·2

For many years no advance was made upon these forms of burner. But when, fifteen years ago, it was recognized that anything which cools the flame reduces its value, while anything which increases its temperature raises its illuminating power, a change began to steal over the forms of burner in use; and

the regenerative burners, fathered by such men as Siemens, Grimston, and Bower, commenced what was really a revolution in gas lighting, by utilizing the heat contained in the escaping products of combustion to raise the temperature of the gas and air which are to enter into combination in the flame. An enormous increase in the temperature of the solid particles of carbon in the flame is thereby obtained; and a far greater and whiter light is the result. The Bower lamp, in which, at any rate in the later forms, the flame burns between a downward and an upward current of air, was one of the first produced; and the latest form gives a very high service. As types of the "inverted cone" regenerative burner, we may also take the "Cromartie" and Wenham lamps, which have been followed by a host of imitators; and so closely are the original types adhered to, that one begins to seriously wonder what the use of the Patent Office really is. The Schülke lamp and one of the latest forms of Siemens regenerative burner, however, stand apart from all the others by dealing with flat and not conical flames; and regeneration is carried to a high degree.

The only drawback to this class of burner is that it is by far the best form of gas stove as well as burner, and that the amount of heat thrown out by the radiant solid matter in the flame is, under some circumstances, an annoyance. On the other hand, we must not forget that this is the form of burner best adapted for overhead lighting, and that nearly every form of regenerative lamp can be used as a ventilating agent; and that with the withdrawal of the products of combustion from the air of the room, the great and only serious objection to gas as an illuminant disappears.

When coal gas is burnt, the hydrogen is supposed to be entirely converted into water vapour, and the carbon to finally escape into the air as carbon dioxide. If this were so, every cubic foot of gas consumed would produce approximately 0·523 cubic foot of carbon dioxide, and 1·34 cubic feet of water vapour; and the illuminating power yielded by the foot of gas will, of course, vary with the kind of burner used.

Roughly speaking, the ordinary types of burner give the following results:—

	Illuminating Power in Candles per Cub. Ft. of Gas Consumed.	Products of Combustion per Candle Power. Carbon Dioxide.	Water Vapour.
Batswing	2·9	0·18 c. ft.	0·46 c. ft.
Argand	3·3	0·16 „	0·40 „
Regenerative	10·0	0·05 „	0·13 „

So that the regenerative forms of burner, by giving the greatest illuminating power per cubic foot of gas consumed yield a smaller amount of vitiation to the air per candle of light emitted. An ordinary room (say, 16 ft. by 12 ft. by 10 ft.) would not be considered properly illuminated unless the light were at least equal to 32-candle power; and in the following table the amount of oxygen used up, and the products of combustion formed by each class of illuminant and burner, in attaining this result, are given. The number of adults who would exhale the same amount during respiration is also stated:—

Illuminants.	Quantity of Materials used.	Oxygen Removed.	Products of Combustion. Water Vapour.	Carbon Dioxide.	Adults.
	Grs.	C. Ft.	C. Ft.	C. Ft.	
Sperm candles	3840	19·27	13·12	13·12	21·8
Paraffin oil	1984	12·48	7·04	8·96	14·9
Gas (London)—	C. Ft.	C. Ft.	C. Ft.	C. Ft.	
Batswing burner	11·0	13·06	14·72	5·76	9·6
Argand „	9·7	11·52	12·80	5·12	8·5
Regenerative „	3·2	3·68	4·16	1·60	2·6

From these data it appears, according to scientific rules by which the degree of vitiation of the air in any confined space is measured by the amount of oxygen used up and carbon dioxide formed, that candles are the worst offenders against health and comfort; oil-lamps come next; and gas least. This, however, is an assumption which practical experience does not bear out. Discomfort and oppression in a room lighted by candles or oil are less felt than in one lighted by any of the older forms of gas-burner. The partial explanation of this is to be found in the fact that, when a room is illuminated with candles or oil, people are contented with a feebler and more local light than when using gas. In a room of the size described, the inmates would be more likely to use two candles placed near their books or on a table, than 32 candles scattered about the room. Moreover, the amount of water vapour given off during the combustion of the gas is greater than in the case of the other illuminants. Water vapour, having a great power of absorbing radient heat from the burning gas, becomes heated; and, diffusing itself about the room, causes a great feeling of oppression. The air also, being highly charged with moisture, is unable to take up so rapidly the water vapour which is always evaporating from the surface of the skin, whereby the functions of the body receive a slight check, resulting in a feeling of *malaise*. Added to these, however, is a far more serious factor, which, up to the present, has been overlooked, and that is that an ordinary gas-flame in burning yields distinct quantities of carbon monoxide and acetylene, the prolonged breathing of which in the smallest traces produces headache and general physical discomfort, while their effect upon plant life is equally marked.

Ever since the structure of flame has been noted and discussed, it has been accepted as a fact beyond dispute that the outer, almost invisible zone which is interposed between the air and the luminous zone of the flame is the area of complete combustion; and that here the unburnt remnants of the flame gases, meeting the air, freely take up oxygen, and are converted into the comparatively harmless products of combustion, carbon dioxide and water vapour, which only need partial removal by any haphazard process of ventilation to keep the air of the room fit to support animal life. I have, however, long doubted this fact; and at length, by a delicate process of analysis, have been able to confirm my suspicions. The outer zone of the luminous flame is not the zone of complete combustion. It is a zone in which luminosity is destroyed in exactly the same way that it is destroyed in the Bunsen burner—*i.e.*, the air penetrating the flame so dilutes and cools down the outer layer of incandescent gas, that it is rendered non-luminous; while some of the gas sinks below the point at which it is capable of burning, with the result that considerable quantities of the products of incomplete combustion (carbon monoxide and acetylene) escape into the air, and render it actively injurious. I have proved this by taking a small platinum pipe with a circular loop at the end—the interior of the loop being pierced with minute holes; and by making a circular flame burn within the loop, so that the non-luminous zone of the flame just touched the inside of the loop, and then by aspiration, so gentle as not to distort the shape of the flame, withdrawing the gases escaping from the outer zone, and analyzing these by a delicate process which will be described elsewhere, I arrived at the following results:—

Gases Escaping from the Outer Zone of Flame.

	Luminous.	Bunsen.
Nitrogen	76·612	80·242
Water vapour	14·702	13·345
Carbon dioxide	2·201	4·966
Carbon monoxide	1·189	0·006
Oxygen	2·300	1·430
Marsh gas	0·072	0·003
Hydrogen	2·388	0·008
Acetylene	0·036	nil.
	100·000	100·000

The gases leaving the luminous flame show that the diluting action of the nitrogen is so great that considerable quantities even of the highly-inflammable and rapidly-burning hydrogen escape combustion; while the products of incomplete combustion are present in sufficient quantity to perfectly account for the deleterious effects of gas-burners in ill-ventilated rooms. The analyses also bring out very clearly the fact that, although the dilution of coal gas by air in atmospheric burners is sufficient to prevent the decomposition of the heavy hydrocarbons, with liberation of carbon, and so destroy luminosity, yet the presence of the extra supply of oxygen does make the combustion far more perfect, so that the products of incomplete combustion are hardly to be found in the escaping gases. These experiments are of the gravest import, as they show, more clearly than has ever been done before, the absolute necessity of special and perfect ventilation where coal gas is employed for the illumination of our dwelling-rooms. It must be remembered, however, that these results were obtained with an open flame, and that combustion becomes more and more complete the hotter the flame; so that with regenerative burners the deleterious properties of the escaping products are reduced to a great extent.

When coal gas was first employed, during the early part of this century, as an illuminating agent, the low pitch of the old-fashioned rooms, and the excess of the impurities in the gas, rendered it imperative that the products of combustion of the sulphur-laden gas should be conducted from the apartment; and, for this purpose, arrangements of tubes, with funnel-shaped openings, were suspended over the burners. The noxious gases were thus conveyed either to the flue or to the open air. But this type of ventilator was unsightly in the extreme; and some few attempts were made to replace it by a more elegant arrangement, as in the ventilating lamp invented by Faraday, and in the adaptation of the same principle by the late Mr. J. O. N. Rutter, of Brighton, who strove for many years to impress the necessity of removing the products of combustion from rooms. But, with the increase of the gas industry, the methods for purifying the gas became gradually more perfect, while the rooms in the more modern houses were made loftier; and the products of combustion, being mixed with a larger volume of air, and not containing so many deleterious constituents, became, if not much less noxious, at all events less perceptible to the nose.

As soon as this point was reached, the ventilating tubes were discarded; and from that day to this the air of our dwelling-rooms has been contaminated by our illuminants, with hardly an effort to alleviate the effect produced upon health. I say "hardly an effort," for Messrs. Boyle tried, by their concentric tube ventilators, to meet the difficulty; while M. de la Garde and Mr. Hammond have each constructed lamps more or less on the principle of the Rutter lamp. However, either from their being somewhat unsightly, or from their lowering the amount of light given out, none of them has met with any great success. In places of public entertainment, where large quantities of coal gas are consumed for illuminating purposes, the absolute necessity for special ventilation gave rise to the "sun-burner," with its ventilating shaft. This, however, affords but a poor illuminating power per cubic foot of gas consumed, due partly to the cooling of the flame by the current of air produced, and partly to its distance from the objects to be illuminated. The great difficulty which, in the whole history of ventilation, has opposed itself to the adoption of proper

arrangements for removing the products of combustion, has been the necessity for bringing low down into the room the tube intended to carry off the gases, and for encasing the burner in such a way that none of the products should escape. But, with the present revolution in gas-burners, this necessity is entirely done away with; and the regenerative burner offers the means of not only removing all the products of combustion, but also of effecting thorough ventilation of the room itself, as a ventilating regenerative burner, consuming 20 cubic feet of gas per hour, and, properly fitted, will not only remove all its own products of combustion, but also more than 5000 cubic feet per hour of the vitiated air from the upper part of the room. The lecturer said he was quite aware that many makers of regenerative lamps did not at all favour the fitting up of ventilating arrangements, which in some cases was a matter of considerable difficulty; but the question was one of such importance, that he trusted the engineering skill which had been so freely displayed in other matters would be extended to this.

Having disposed in a few words of a subject which, if fully treated, would itself occupy a long course of lectures, we will pass on to the consideration of gas as at present used as fuel. There is no doubt that gas is the most convenient, and in many ways one of the best forms of fuel for heating and cooking; and the efforts which all large gas companies are now making to popularize and increase the use of gas for such purposes will undoubtedly bear fruit in the future. But before the day can come for gas to be used in this way on a large scale, there is one fact which the gas manager and gas-stove manufacturer must clearly realize and submit to, and that is, that no gas-stove or gas water-heater of any construction should be sent out or fitted without just as great care being taken to provide for the carrying away of the products of combustion as if an ordinary fuel range was being fitted. Do not for one moment allow yourselves to be persuaded that because a gas-stove or a geyser does not send out a mass of black smoke, the products of combustion can be neglected, and with safety be allowed to mingle with the atmosphere to be breathed. Scarcely a winter passes without one or more deaths being recorded from the products of combustion given off from various forms of water-heaters used in bath-rooms; scarcely a cookery lesson with gas-stoves is given without one or more ladies having to leave, suffering from an intense headache, and often in an almost fainting condition. And the cause which brings about these extreme cases, on a small scale gives rise to such physical discomfort to many delicately-organized persons, that a large class exist who absolutely and resolutely refuse to have gas as an illuminant or fuel in any of their living-rooms; and if the use of gas, more especially as fuel, is to be extended, and if gas is to hold its own in the future, those interested in gas and gas-stoves must face the problem, and, by improving the methods of burning and using gas, do away with the serious drawback to its use which now exists.

The feeling has gradually been gaining ground in the public mind that, when atmospheric burners and other devices for consuming coal gas are employed for heating purposes, certain deleterious products of incomplete combustion find their way into the air; and that this does take place to a considerable extent is shown by the facts brought forward in a paper read by Mr. W. Thomson at the last meeting of the British Association, at Leeds (see *ante*, pp. 602, 996). Mr. Thomson attempted to separate and determine the quantity of carbon monoxide and hydrocarbons found in the flue gases from various forms of gas stoves and burners; but, like every other observer who has tried to solve this most difficult problem, he found it so beset with difficulties, that he had to abandon it, and contented himself with determining the total quantities of carbon and hydrogen escaping in an unburnt condition. His experiments proved that the combustion of gas in stoves for heating purposes is much more incomplete than one had been in the habit of supposing; but they did not show whether the incompletely burnt matter consisted of such deleterious products as carbon monoxide and acetylene, or comparatively harmless gases such as marsh gas and hydrogen. After three years of continuous work upon the subject, I have succeeded in doing this by a very beautiful process of analysis which will shortly be made known through the Society of Chemical Industry; and I now wish to lay some of my results before you.

If a cold substance—metallic or non-metallic—be placed in a flame, whether it be luminous or non-luminous, it will be observed that there is a clear space, in which no combustion is taking place, formed round the cool surface, and that, as the body is heated, this space becomes gradually less, until, when the substance is at the same temperature as the flame itself, there is contact between the two. Moreover, when a luminous flame is employed in this experiment, the space still exists between the cool body and the flame; but it will also be noticed that the luminosity is decreased over a still larger area, though the flame exists. This means that in immediate contact with the cool body, the temperature is so reduced that a flame cannot exist, and so is extinguished over a small area; while over a still larger space the temperature is so reduced that it is not hot enough to bring about decomposition of the heavy hydrocarbons, with liberation of carbon, to the same extent as in hotter portions of the flame. Now, inasmuch as, when water is heated or boiled in an open vessel, the temperature cannot rise above 100° C., and as the temperature of an ordinary flame is more than 1000° C., it is evident that the burning gas can never be in contact with the bottom of the vessel; or, in other words, the gas is put out before combustion is completed, and the unburnt gas and products of incomplete combustion find their way into the air, and render it perfectly unfit for respiration. The portion of the flame which is supposed to be the hottest is about half an inch above the tip of the inner zone of the flame. It is at this point that most vessels containing water to be heated are made to impinge on the flame; and it is this portion of the flame also that is utilized for raising various solids to a temperature at which they will radiate heat in most forms of gas-stove.

In order to give an insight into the amount of contamination which the air undergoes when a geyser or a cooking-stove is at work, I have determined the composition of the products of combustion and the unburnt gases escaping when a vessel containing water at the ordinary temperature is heated up to boiling-point by a gas-flame; the vessel being placed in the first case half an inch above the inner cone of the flame, and in the second at the extreme outer tip of the flame. The results are given in the following table:—

Gases escaping during Checked Combustion.

	Bunsen Flame.		Luminous Flame.	
	Inner.	Outer.	Inner.	Outer.
Nitrogen	75·75	79·17	77·52	69·41
Water vapour	13·47	14·29	11·80	19·24
Carbon dioxide	2·99	5·13	4·93	2·38
Carbon monoxide	3·69	nil.	2·45	2·58
Marsh gas	0·51	0·31	0·95	0·39
Acetylene	0·04	nil.	0·27	nil.
Hydrogen	3·55	0·47	2·08	nil.
	100·00	100·00	100·00	100·00

These figures are of the greatest interest, as they show conclusively that the extreme tip of the Bunsen flame is the only portion which can be used for heating a solid substance without liberating deleterious gases. This corroborates the previous experiment on the gases in the outer zone of a flame, which showed that the outer zone of the Bunsen flame is the only place where complete combustion is approached. Moreover, this work sets at rest a question which has been over and over again under discussion, and that is whether it is better to use a luminous or a non-luminous flame for heating purposes. Using a luminous flame, it is impossible to prevent a deposit of carbon, which is kept by the flame at a red heat on its outer surface; and the carbon dioxide formed by the complete combustion of the carbon already burnt up in the flame, is by this reduced back to carbon monoxide. So that, even in the extreme tip of a luminous flame, it is impossible to heat a cool body without giving rise to carbon monoxide, although, acetylene being absent, gas-stoves in which small flat-flame burners are used have not that subtle and penetrating odour which marks the ordinary atmospheric burner stove with the combustion checked just at the right spot for the formation of the greatest volume of noxious products. It is the contact of the body to be heated with the flame before combustion is complete, that gives rise to the great mischief. Any cooling of the flame extinguishes a portion of it; and the gases present in it at the moment of extinction creep along the cooled surface, and escape combustion.

Dr. Blochmann has shown the composition of the gases in various parts of the Bunsen flame to be as follows:—

Height above tube.	In tube	1 in.	2 in.	3 in.	Complete combustion
Air with 100 vols. of gas	253·9	284·7	684·5	484·3	608·8
Hydrogen	48·6	36·4	17·7	16·1	nil.
Marsh gas	39·0	40·1	28·0	5·7	nil.
Carbon monoxide	2·9	2·2	19·9	12·7	nil.
Olefiant gas	4·0	3·4	2·2	nil.	nil.
Butylene	3·0	2·5	1·6	nil.	nil.
Oxygen	50·7	52·0	21·7	nil.	nil.
Nitrogen	199·8	223·8	225·9	382·4	432·3
Carbon dioxide	0·3	3·5	18·0	41·7	62·4
Water vapour	3·1	11·8	45·3	116·1	140·2

This shows that it would be impossible to check the flame anywhere short of the extreme tip (where complete combustion is approximately taking place) without liberating deleterious products.

In utilizing a flame for heating purposes combustion must be completed before any attempt is made to use the heat, in other wards the products of combustion and not the flame must be used for this purpose.

I think I have said enough to show that no geyser or gas-stove should be used without ample and thorough means of ventilation being provided; and no trace of the products of combustion should be allowed to escape into the air. Until this is done, the use of improper forms of stoves will continue to inflict serious injury on the health of the people using them; and this will gradually result in the abandonment of gas as a fuel, instead of, as should be the case, its coming into general use. The English householder is far too prone to accept what is offered to him, without using his common sense; and he will buy the article which pleases his eye the most, and affects his pocket the least, on the bare assurance of the shopkeeper, who is only anxious to sell. But when he finds his health and comfort are in jeopardy, he discards the gas-stove; and when

he has done so, it will take years of labour to convince him that it was the misuse of gas which caused his trouble. Already signs are not wanting that the users of gas-stoves are beginning to fight shy of them; and I earnestly hope that the gas managers of the kingdom will bring pressure to bear upon the stove makers to give proper attention to this very serious question. So strongly do I feel its great importance to the gas world and the public at large, that I freely offer to analyze the products of combustion given off by any gas-stove or water heater sent to me at Greenwich during the next six months; but on one condition—namely, that the results, whether good, bad, or indifferent, are to be published in a paper to be read before the Society of Arts, which has always been in the front when matters of great sanitary importance to the public have had to be taken up, If, after that, the public like to buy forms of apparatus which have not been certified, it is their own look-out; but I certainly do think that the maker of any stove or geyser which causes a death should be put upon his trial for manslaughter.

Let us now consider for a moment what is likely to be the future of gas during the next half century. The labour troubles, bad as they are and have been, will not cease for many a weary year. The victim of imperfect education—more dangerous than none at all, as, while destroying natural instinct, it leaves nothing in its place—will still listen to, and be led by the baneful influence of irresponsible demagogues, who care for nothing so long as they can read their own inflammatory utterances in the local press, and gain a temporary notoriety at the expense of the poor fools whose cause they profess to serve. The natural outcome of this will be that every possible labour-saving contrivance will be pressed into the gas manager's service, and that although coal (of a poorer class than that now used) will still be employed as the source of gas, the present retort-setting will quickly give way to the inclined retorts on the Coze principle; while instead of the present wasteful method of quenching the red-hot coke, it will, as far as it can be used, be shot direct into the generator of the water-gas plant, and the water gas, carburetted with the benzene hydrocarbons derived from the smoke of the blast-furnaces and coke-ovens, or from the creosote oil of the tar distiller, by the process foreshadowed in the concluding sentences of the preceding lecture, will then be mixed with the gas from the retorts, and will supply a far higher illuminant than we at present possess. In parts of the United Kingdom such as South Wales, where gas coal is dear and anthracite and bastard coals are cheap, water gas, highly carburetted, will entirely supplant coal gas, with a saving of 50 per cent. on the prices now existing in these districts.

While these changes have been going on, and improved methods of manufacture have been tending to the cheapening of gas, it will have been steadily growing in public favour as a fuel; and if, in years to come, the generation of electricity should have been so cheapened as to allow the electric light to successfully compete with gas as an illuminant, the gas-works will still be found as busy as of yore, and the holder of gas shares as contented as he is to-day; for, with the desire for a purer atmosphere and white mist instead of yellow fog, gas will have largely supplanted coal as a fuel, and gas-stoves, properly ventilated and free from the reproaches I have hurled at them to-night, will burn a gas far higher in its heating power than that we now use, far better as regards its capacity for bearing illuminating hydrocarbons, and entirely free from poisonous constituents. As soon as the demand for it arises, hydrogen gas can be made as cheaply as water gas itself; and when the time is ripe for a fuel gas for use in the house, it is hydrogen and not water gas that will form its basis. With carburetted water gas and 20 per cent. of carbon monoxide, we shall still be below the limit of danger; but a pure water gas, with more than 40 per cent. of the same insidious element of danger, will never be tolerated in our households. Already a patent has been taken by Messrs. Crookes and Ricarde-Seaver for purifying water gas from carbon monoxide, and converting it mainly into hydrogen by passing it at a high temperature through a mixture of lime and soda lime—a process which is chemically perfect, as the most expensive portion of the material used could be recovered.* In the present state of the labour market, however, it is not practical, as, for the making of every 100,000 cubic feet of gas, 15 tons of material would have to be handled, The cost of labour alone would thus be sufficient to prevent its being adopted; and, moreover, hydrogen can be made directly far cheaper.

From the earliest days of gas making, the manufacture of hydrogen by the passage of steam over red-hot iron has been over and over again mooted and attempted on a large scale; but several factors have combined to render it futile. In the first place for every 478·5 cubic feet of hydrogen made under perfect theoretical conditions never likely to be obtained in practice, 56 lbs. of iron were converted into the magnetic oxide; and as there was no ready sale for this article, this alone would prevent its being used as a cheap source of hydrogen. The next point was that, when steam was passed over the red-hot iron, the temperature was so rapidly lowered that the generation of gas could only go on for a very short period. Finally, the swelling of the mass in the retort, and the fusion of some of the magnetic oxide into the side, renders the removal of the spent material almost an impossibility. These difficulties can, however, be overcome. Take a fire-clay retort 6 feet long and 1 foot in diameter, and cap it with a casting bearing two outlet tubes closed by screw-valves, while a similar tube leads from the bottom of the retort. Enclose this retort, set on end, by a furnace chamber of iron, lined with fire-brick, leaving a space of 2 ft. 6 in. round the retort; and connect the top of the furnace chamber with one opening at the top of the upright retort, while an air-blast is led into the bottom of the furnace chamber below rocking fire-bars, which start at the bottom of the retort, and slope upwards to leave room for ash-holes closed by gas-tight covers. The retort is filled with iron or steel borings—alone if pure hydrogen is required, or cast into balls with pitch if a little carbon monoxide is not a drawback, as in foundry work. The furnace chamber is filled with coke, fed in through manholes or hoppers in the top; and the fuel being ignited, the blast is turned on, and the mixture of nitrogen and carbon monoxide formed passes over the iron, heating it to a red heat, while the incandescent coke in contact with the retort does the same thing. When the fuel and retort full of iron are at a cherry-red heat, the air-blast is cut off, and the pipe connecting the furnace and retort, together with the pipe in connection with the bottom of the retort, is closed. Steam, superheated by passing through a pipe led round the retort or interior wall of the furnace, is injected at the bottom of the red-hot mass of iron, which decomposes it, forming magnetic oxide of iron and hydrogen, which escape by the second tube at the top of the retort, and are led away—to a carburetting chamber if required for illumination, or else direct to the gasholder if wanted as a fuel; the mass of incandescent fuel in the furnace chamber surrounding the retort keeping up the temperature of the retort and iron sufficiently long to enable the decomposition to be completed. The hydrogen and steam valves are now closed, and the air-blast turned on; and the hot carbon monoxide, passing over the hot magnetic oxide, quickly reduces it down again to metallic iron, which, being in a spongy condition, acts more freely on the steam during later makes than it did at first, and, being infusible at the temperature employed, may be used for a practically unlimited period. What more simple method than this could be desired? Here we have the formation of the most valuable of all fuel gases at the cost of the coke and steam used—a gas also which has double the carrying power for hydrocarbon vapours possessed by coalgas, while its combustion gives rise to nothing but water vapour.

In this course of lectures, I have left much unsaid and undone which I should like to have had time to accomplish; and if I have been obliged to leave out of consideration many important points, it is the time at my disposal, and not my desire, which is to blame. In bringing them to a conclusion, I wish to express my thanks to my assistants, Messrs. J. A. Foster and J. B. Warden, who have heartily co-operated with me in the preparation of the original portion of the matter I have brought before you: and I now leave the criticism of the lectures in your hands, hoping you will see in them an earnest desire to do my mite in advancing the most useful industry the country possesses.

In illustration of the portion of the lecture dealing with gas-burners, several of the latest types of regenerative lamps were shown in action, and described by Professor Lewes, to whom a hearty vote of thanks was accorded, on the proposition of the Secretary of the Society (Sir Henry Trueman Wood), for the able way in which he had treated the important subject selected for the first course of Cantor Lectures for the session.

The Mineral Resources of Norway.—Norway can scarcely be called a country of great mineral wealth, says a correspondent of *Iron*; but gold, silver, iron, copper pyrites, nickel, zinc, lead, and apatite are found all over the country, and have been worked with more or less success, chiefly by English companies. Iron ores are widely distributed throughout the country; but are generally so poor that they do not now pay to work. Most of them contain from 40 to 45 per cent. of iron. Some years ago charcoal iron of excellent quality was produced in South Norway, which found a ready market in this country for making the finest kinds of steel; but the Cumberland and Spanish ores, with the new processes invented, have destroyed the trade. In fact, at the present moment there is not a single iron-works or furnace in Norway. Copper has been wrought in many parts. At present an English company is working copper mines in the district of Thelemaken. The principal mine is the crown mine at Röraas, where 300 tons of refined copper are produced in a year. The greatest mining enterprise in Norway was until recently the Vigsnæs Copper Mine in Karm Island, owned by a Franco-Belgian company, with a capital of £64,000. The pyrites generally contained 40 to 42 per cent. of sulphur, and 3 to 4 per cent. of copper. But after being worked at a good profit for twenty years, the ore has given out; and the working ceased last autumn in consequence. Zinc is worked profitably by an English company at Saude, near Stavanger; but operations have not been of long duration. Apatite is found in considerable quantities in Southern Norway. A French company is working a deposit there with great success.

* This process was described in the JOURNAL for May 20 last (p. 930).

AMERICAN GASLIGHT ASSOCIATION.

[Abridged from the "Official Report" in the *American Gaslight Journal*.]

(*Concluded from p.* 1293.)

At the close of the discussion on Mr. Shelton's paper on "The Gas Engineer and his Pencil," several matters relating to the business of the Association came on for consideration. The recommendation of the President, that, "at all subsequent meetings, no hospitality in the way of a banquet be accepted by the Association," was adopted; and the announcement of that decision was received with applause. It was decided that the election of officers should take place immediately before the close of the final business session of the Association; and that the officers-elect should enter upon the discharge of their respective duties on the Saturday succeeding the third Wednesday in October of each year. The recommendation from the Committee that the place of next meeting should be New York was accepted.

Mr. W. P. Fodell, of Philadelphia, Pa., read a paper entitled, "Suggestions of Methods and Systems for Recording the Histories and Accounts of Gaslight Companies." He said he proposed to divide the business into four departments, each of which should have its distinct set of books. These were: The engineer's department, dealing with manufacture, distribution, and products; the rental department, for the registration of consumers; the receivers' department, for the collection of accounts due; and the secretary and treasurer's department. The books should show the exact history and cost of each operation; and the distinct charges to capital and revenue should be accurately stated in each instance. All renewals should be put to profit and loss, and extensions or additions charged to capital. When replacing apparatus with larger, the value of the increased productiveness only should be charged to capital account. He approved of the formation of depreciation funds, to provide for the renewal, when necessary, of machinery that was continually wasting or wearing away. The latter part of the paper dealt with the mode of preparing a revenue account for the year, and for working out the cost of gas in the holder, distribution, &c.

After a short conversational discussion, Mr. H. C. Adams read a paper on "The Gas Coals of the United States," the first portion of which is given elsewhere.

A paper on "The Practical Efficiency of an Illuminating Water-Gas Setting" was read by Mr. A. G. Glasgow, of Philadelphia, Pa., who said that his paper treated exclusively of apparatus of the Lowe type, in which the energy of the generator blast products was utilized in gasifying the enriching oil through the medium of a superheater; and that his figures referred to unpurified carburetted gas at 60° Fahr. The generator fire should be kept as nearly as possible at the best temperature for production. This necessitated short runs and blows; the relative length of each being determined by practical trial. There should always be a sufficiency, but never an excess of steam; and the blasts should be so adjusted that the generator and superheater reached their proper respective temperatures simultaneously. All carbonic oxide should be consumed in the superheater, and this without a greater excess of air than was necessary to keep the bricks clean. Working under these conditions, he had experimented with a view of ascertaining whether the whole of the heat generated was accounted for. A carefully-selected average showed that for each 1000 cubic feet of gas produced there were charged into the generator 33·4 lbs. of anthracite, of which 9·9 lbs. remained as ash and unconsumed coal; leaving a net consumption of 23·5 lbs. which might be taken as pure carbon, having a heating equivalent of 14,500 units per pound. The carburetted gas contained 3·8 per cent. of impurities, and 1 per cent. of nitrogen. The remainder consisted of 35·6 per cent. of hydrogen, 28 per cent. of carbonic oxide, 17 per cent. of marsh gas, and 14·6 per cent. of illuminants. The uncarburetted gas comprised 51·8 per cent. of hydrogen and 43·4 per cent. of carbonic oxide. The generator blast gases consisted of 72·5 per cent. of nitrogen, 17·8 per cent. of carbonic oxide, and 9·7 per cent. of carbonic acid; and the burnt gases from the superheater, of 17·4 per cent. of carbonic acid, 3·2 per cent. of oxygen, and 79·4 of nitrogen. The composition by weight, per 100 cubic feet, and specific heat of each gas were also stated in the paper. The 340,750 heat-units generated by the combustion of the 23·5 lbs. of carbon would be represented by the energy of the carbonic oxide produced, heat rendered latent by the decomposition of steam and gasification of oil, difference between the temperature of the escaping gas and that of the entering oil, heat carried off by the escaping blast products, and by radiation and convection from the exterior of the apparatus, and by the temperature of the residual ash from the generator. These various quantities he arrived at as follows:—

	Units.
Energy of carbonic oxide	91,043
Heat rendered latent by decomposition of steam	90,553
Difference in temperature of escaping gas and of entering oil	26,864
Heat carried off by escaping blast products	74,152
Heat lost by radiation	12,454
Do. by convection	15,696
Heat rendered latent by gasification of oil	11,496
Sensible heat in ash, &c.	3,712

This accounted for the 340,750 units of heat, with the exception of about 4 per cent.; and he calculated that the efficiency of the apparatus, as a heat-machine, was 61 per cent.—leaving a waste of 39 per cent. Some 2457 cubic feet of air and 5 gallons of petroleum were supplied per 1000 cubic feet of gas made. The illuminating power of the gas was 31 candles; and its calculated specific gravity, ·6355. After allowing one-seventh for the tar, he calculated that 30 lbs. of petroleum passed into each 1000 cubic feet of the gas. This, at the usual estimate of 20,000 units per pound, would represent 600,000 units. The heating power of the carburetted gas was 764, and that of the uncarburetted gas 327 units per cubic foot; and he estimated that 553,000 units were recovered in the gas. The various temperatures recorded in the foregoing experiments were taken by means of copper balls and a pyrometer; and the quantity of blast gas was arrived at by means of an anemometer. Small lighting cups of cast iron were screwed to the exterior casing of the apparatus, and filled with mercury; the temperature of the mercury being taken to represent that of the outside shell. An ingenious contrivance was used to measure the loss of heat by radiation and convection, comprising a casing covering 4 square feet of surface, through which air could be passed, and a layer of water 3 inches thick. Passing air through at a rate regulated so that the temperature on the shell inside the case was exactly the same as that of any other part, the volume and increased temperature of the air passed gave the heat lost by convection; the increase of temperature in the tank giving the loss by radiation.

The President having invited discussion, Mr. Forstall said it would be a good plan to fix upon the total theoretical quantity of carbon necessary to produce 1000 cubic feet of gas, and this would serve as a standard to indicate the efficiency of any apparatus. To arrive at this, he had calculated how much of the total carbon was represented by an analysis of the water gas, and how much by the heat necessary to furnish the hydrogen found in the gas. He ascertained that 9·1 lbs. of carbon were represented in his water gas; and that by converting the carbon into carbonic oxide and carbonic acid, in the proportions used in practice, 11·2 lbs. of carbon were needed to decompose the steam. Assuming, however, that the carbon was entirely converted into carbonic acid, 4 lbs. of carbon would be enough for this purpose. Then about 0·8 lb. of carbon was required to gasify the oil; so he arrived at a total of 13·9 lbs., which left a margin of about 9 lbs. of carbon that might possibly be saved. He believed that it would be worth while to screen the ashes, for the separation of the unused fuel from them. Mr. Norris said he frequently met with analyses of blast gases in which there appeared to be a deficiency of oxygen. The proportion of oxygen that should be present could readily be calculated from the nitrogen or hydrogen; and he would like to ask for information on this point. Mr. Rusby directed attention to the fact that the loss by blast gases escaping from the stack was greater than all the other causes of loss combined. Some of this might be turned to account for heating the air-blast.

Mr. Glasgow, in replying, said he had noticed the discrepancies observed by Mr. Norris, and thought they must be due to errors in making the analysis, &c. He agreed with Mr. Forstall that the best possible result to be hoped for was about 13 lbs. of carbon per 1000 cubic feet of gas. While it might pay to screen cinders from hard coal, he did not find it worth while to do so from Kansas coke. The latter, however, left less residue than the coal. He could do with 30½ lbs. of coke against 34½ lbs. of coal; and the difference was due to the screenage.

Mr. A. E. Boardman, of Macon, Ga., read a paper entitled "Hints on Electric Lighting by Small Gas Companies." While he had previously advocated the adoption of electric lighting by gas companies, further experience led him to apply to small gas companies about to embark in electric lighting, the advice given by *Punch* to the young man who was going to be married. It was true that there was a saving in establishment expenses by having the gas and electric works under one management; also that a gas company could afford to supply electricity on cheaper terms than a company devoted specially to that business. It did not, however, necessarily follow that the gas company would make more money by undertaking electric lighting than by leaving it alone. Fair profits had certainly been realized in some cases; but if the same amount of capital as was devoted to the electric lighting plant had been spent in improving the gas-works and the mains, greater profits could and would be made in the long run. Those who had only talked with the agents of electric lighting systems as to the cost of installing and operating would be inclined to question this; but others who had worked the thing for a year or two, collecting the rents and paying the expenses, would have a suspicion that there was some truth in it. One reason why electric installations did not pay so well as might be expected, was the high prices charged on the whole of the appliances required; and another was the frequent mishaps that occurred through freaks of the electric light that were entirely beyond their control or knowledge, entailing expensive repairs. These were never allowed for; but they happened more or less frequently. An electric light plant paid best when working to its maximum capacity; but in practice this could not be done, as a demand for a few more lights necessitated either a lowering of the candle power all round or the erection of more machinery. Assuming that his first hint was not accepted, he advised that the machinery and plant should be purchased from the best and most reliable makers; and he recommended that the contractor should be bound not only to furnish, but to erect and turn over

the plant in good order after a month's working test. Much trouble would be saved if it was also understood that the plant should be passed by the insurance experts, and also by the city authorities, as satisfactory. Another desirable thing was an indemnity from actions or damages arising from the claims of rival patentees. A high-speed engine with direct belting was usually stated to be better than a slow-speed engine with countershafting, as conducing to economy, compactness, less risk of belts slipping, &c. But here, again, he would say, "Don't." He had found high-speed engines expensive to operate and maintain; and at two stations he had substituted slow-speed ones with countershafting, and the results had been satisfactory. By "high-speed" he meant (say) 180 revolutions per minute; and by "slow-speed," about half that number. He preferred arc lighting, as the expense of operating and maintaining the incandescent light was much greater, and the income to be derived therefrom was much less. Incandescent lamps supplied at the equivalent of 6s. 3d. per 1000 cubic feet of gas would not yield large dividends; and the consumers did not expect to pay the cost of renewals when the lamps wore out. A 52-volt lamp lasted longer than a 72 or a 110 volt lamp. He had tried incandescent lighting by separate dynamos and circuits, as well as by means of series lamps on the arc circuit; but neither had proved a paying undertaking. It had enabled him to keep out competition, both in the gas business and in the electric field; but in both instances the gas-works alone, if safe from "wreckers," would have paid much better.

In the subsequent discussion, Mr. Egner very cordially agreed with the remark as to the superiority of slow-speed engines; though there were, he said, occasions when high-speed ones might be preferable. About two years ago, he built gas-works in a town where an electric company supplying both arc and incandescent systems were already in full operation; and the result was that the electric people were very glad to buy him out. Mr. Gimper did not entirely agree with the opinions advanced in the paper, though he did not advise small gas companies to compete with an electric light plant in their town. If they had the thing all to themselves, it was as well to go in for it, if only as a protection. Mr. Coggshall said he had taken up the electric business, and, so far, did not regret it; and he would advocate the same thing again. Mr. Wilcox said he worked a high-speed engine at 250 revolutions per minute, and used 5·13 lbs. of coal per horse power; while a low-speed one, at 75 revolutions per minute, only used 3·6 lbs., and did not require anything like so much attention.

Mr. Boardman, in reply, said he had entered upon arc electric lighting in consequence of a rival company being formed in his district; and the result was that he was able to buy them out. The incandescent system was also forced upon him by the formation of a rival gas company. He had not heard of a successful electric meter; and, in the absence of one, he found it to be a fact that people would use the light for a longer time than they contracted for. The effect of introducing electricity, whether by a rival company or by one's own, was an increased sale of gas. At the same time the introducer of it lost money.

The question-box was next opened. One question was, "Is there any good reason why gas companies should not do the pipe fitting of houses, and furnish all kinds of appliances, at cost?" Mr. Pratt said he thought there was one—that they would have to keep a large stock; but it might be done in particular cases, to secure a customer. Mr. Bowen thought it advisable do so whenever there was a chance of extending business. He had been compelled to take such a course by the competition of the electric light. Mr. Findlay agreed it was wise to do fitting work in cases of competition. Mr. Littlehales said one reason against the proposition was that it would antagonize the gas-fitters, who were really permanent canvassers, having an interest in securing work. The President pointed out that while a plumber would not be liable for accidents arising from carelessness, a company would certainly be held responsible.

In reply to another question, Mr. Egner said that the saving of gas secured by the prompt charging and closing up of inclined retorts on the Coze system was 10 to 15 cubic feet per charge. In reference to an inquiry as to whether he preferred water gas to the Coze system, he said this was entirely a question of circumstances. If the price of materials was at all favourable, water gas could be made even cheaper than coal gas by the Coze process.

An Electric Standards Committee.—The President of the Board of Trade has appointed a Committee, consisting of the following gentlemen, to consider whether any, and, if so, what steps should be taken for the provision of electrical standards: Lord Rayleigh, F.R.S., and Sir W. Thompson, F.R.S., representing the Royal Society; Professor G. Carey Foster, F.R.S., and Mr. R. T. Glazebrook, F.R.S., representing the British Association for the Advancement of Science; Dr. J. Hopkinson, F.R.S., and Professor W. E. Ayrton, F.R.S., representing the Institution of Electrical Engineers; Mr. E. Graves, and Mr. W. H. Preece, F.R.S., representing the General Post Office; and Mr. Courtenay Boyle, C.B., and Major P. Cardew, R.E., representing the Board of Trade. Sir T. Blomefield, of the Board of Trade, will be the Secretary to the Committee.

ELECTRIC LIGHTING PROGRESS IN LONDON.

At the Meeting of the Society of Arts on the 10th inst., a paper on the above subject was read by Mr. F. Bailey, Assoc. M. Inst. C.E. The following is an abstract of the communication, which was briefly mentioned in the Journal last week.

The author began by stating that the difficulties and obstacles which were retarding the progress of electric lighting when Mr. R. E. B. Crompton submitted to the Society a paper on the subject in 1888 had been to a great extent removed; and that a number of companies had obtained statutory powers to lay mains within certain specified areas in London. He therefore proposed to give a general account of the work done and in progress by these companies, and furnish some details as to the generating stations and the systems of supply in use. Having given a few particulars of early exhibitions of the electric light in London, Mr. Bailey said that practically nothing was done in the way of its general distribution before the establishment of the Grosvenor Gallery station by Mr. Ferranti and those who were associated with him. It had been frequently stated that the Electric Lighting Act of 1882 did much towards stifling inordinate speculation; but, in attempting to make people wise by this Act of Parliament, a very serious check had been placed upon the development of electrical progress. The enormous strides which had been made under the more encouraging Act of 1888 would convince everyone that it was urgently required; and one of its consequences had been a deluge of applications to the Board of Trade for Provisional Orders. After a full inquiry by Major Marindin, these were in due course granted. The author then proceeded to give particulars of the principal companies and their work.

The Kensington and Knightsbridge Company commenced operations, with a capital of £300,000, under the name of the Kensington Court Electric Light Company, in the autumn of 1886, under Mr. Crompton's guidance; and they commenced to supply current in January, 1887, using underground mains, and running their plant in a temporary building. The Board of Trade Licence under which the work was started was incorporated in the Company's Provisional Order of 1889, which authorizes them to supply a portion of the parish of Kensington, St. Mary Abbots, and the detached portion of the parish of St. Margaret, Westminster. The direct current is employed, in conjunction with secondary batteries; the pressure being 200 volts on the three-wire system, with 100 volts in the houses. The batteries are charged at any convenient time when the engines have power to spare, and not only act as a sponge, which can be squeezed when the engine plant requires assistance, but also as regulators, as well as maintaining the supply during the hours of minimum demand. Two generating stations are erected—one at Kensington Court, and the other at Chapel Place, Knightsbridge; the plant consisting of boilers, feed-water heaters, and compound engines, combined direct with Crompton dynamos and Howell batteries, in both stations. There is also a battery station situated near the centre of the Kensington district at Queen's Terrace Mews, where two large batteries are placed. In all cases ample space is provided for the future extension of the plant when required. Arrangements are provided on the Kensington Court station switchboards to enable any dynamo to be used for charging the distant battery station, to which a pair of charging mains are laid. Culverts, constructed with concrete or brickwork, are laid under the pavements; and bare copper conductors, supported at intervals by glass insulators, are placed therein. The conductors are composed of copper strips 1 inch by ¼ inch, laid one over the other so as to make up the total section required. In cases where there is no room under the pavement for building up the culvert, wrought-iron gas tubing is used; and cables insulated with thick vulcanized rubber are drawn through and connected to the bare conductors. Numerous service-boxes are fixed in the pavements, to enable houses to be connected without opening the ground. Some 4½ miles of pipes with cables have been laid; and on the 1st inst., lamps were connected equivalent to 24,850 32-watt lamps. The Company's Engineer (Mr. H. W. Miller) states that the lamp supply, or maximum number of lamps in use at one moment, is between 30 and 40 per cent. of the lamp connection. The number of lamps per mile of mains was 2366.

The House-to-House Company, whose capital is £350,000, have a large area of supply, consisting of two detached districts practically North Kensington and West Brompton. The generating station is situated off the Richmond Road, West Brompton, and contains space for a very large plant. The Lowrie-Hall alternating current transformer system is adopted, with 2000 volts on the mains. Four principal mains at present carry the current from the station; the transformers being connected to these mains where required. Cast-iron pipes are laid to form a conduit into which vulcanized india-rubber cables are drawn; suitable manholes, covers, and junction-boxes being provided. At present the demand for light is supplied from a plant consisting of three boilers, working at 150 lbs. pressure per square inch; three compound horizontal engines, each of 200 indicated horse-power; three alternators, each of 100 units 2000 volts; and three exciters, each of 3 units. The engines work at a speed of 88 revolutions per minute; each engine driving an alternator by 7 cotton ropes, the exciter for each alternator being driven by cotton ropes from the alternate pulley. The

Company's Manager (Mr. Hall) states that on their lamp connections, equivalent to 12,898 lamps of 8-candle power, the maximum supply is equivalent to 5430 lamps of 8-candle power—say, 42 per cent. The number of lamps per mile of mains is 1517.

The St. James's and Pall Mall Electric Lighting Company was formed, with a capital of £100,000, for the purpose of supplying the whole of the parish of St. James's, Westminster; and they commenced to supply current, under their Provisional Orders, from their station in Mason's Yard, Duke Street, on April 4, 1889. The direct current is employed, without batteries. At present this station supplies the southern half of the district. The total plant consists of five boilers, working at 150 lbs. per square inch; two large feed-water heaters; ten compound engines, each of 200 indicated horse power, and two of 80 indicated horse power each; and twelve dynamos, driven direct from the engines. The mains consist of a network of conductors on the three-wire system, supplied at about 100 volts at the station. A cast-iron trough or culvert is laid under the surface of the pavement; and three conductors, each consisting of a number of strips of bare copper, are carried by porcelain bridges, at suitable intervals apart. To avoid any risk of the mains touching each other, porcelain distance-pieces are placed over the mains. A cast-iron lid, with water-tight joint, covers the trough. Connection to customers' houses is made by drawing well-insulated cable through gas tubing, which is screwed into the trough. On the 5th inst., 23,174 lamps of 8-candle power, or their equivalent, were connected. The Company's Engineer (Mr. Dobson) states that the maximum lamp supply is equal to about 13,222 lamps of 8-candle power—say, 57 per cent. The number of lamps per mile of mains was 5452.

The district in which the Westminster Electric Supply Corporation, Limited, are authorized to supply electricity, comprises that portion of the united parishes of St. Margaret and St. John, Westminster, which lies to the south of the centre line of the Metropolitan District Railway, and the portion of the parish of St. George, Hanover Square, covering Belgravia and Mayfair. The system adopted is similar to that of the Kensington and Knightsbridge Company—viz., direct current, in conjunction with batteries used as regulators, and also for supply during the hours of minimum demand. Three stations are being erected —one at Millbank Street, one at Eccleston Place, and one in Davies Street. Current is at present being supplied from the Millbank Street station, and from a small temporary station in Dacre Street. The other two stations are being pushed forward as fast as possible, in order to supply from all stations early next year. Mains are being laid for a three-wire distribution; Messrs. Crompton being the contractors for the Westminster district, where the system is similar to that put down for the Kensington and Knightsbridge Company. For other parts of the district, Professor Kennedy, the Engineer to the Company, has devised a system. Bare copper strip rests on stoneware insulators placed from 6 to 8 feet apart, and bedded in a conerete culvert. The feeders are used in a very systematic manner.

The parliamentary powers possessed by the London Electric Supply Corporation, Limited, whose capital is £1,250,000, cover a large area, comprising the district bordering the south side of the Thames, from Westminster Bridge to Greenwich, Mayfair, Belgravia, St. James's, and Pall Mall, St. Martin's-in-the-Fields, part of Westminster, Chelsea, and two isolated areas—Newington and Clerkenwell. The Ferranti system is employed throughout; alternating current being generated at an extra high pressure, and transmitted to converting stations, from which it is distributed at high pressure to the service converters. The Corporation have, as our readers are aware, erected a large station at Deptford. The plant consists of 24 boilers, four compound vertical engines, two of which are of 1500, and two of 750 indicated horse power each. Each of these engines drives a Ferranti dynamo by cotton ropes; the exciters being worked direct from independent engines. In order to convey the high pressure from Deptford to London, Mr. Ferranti devised a special form of main, about 28 miles of which have been laid; the distributing mains from the stations being of various kinds.

The Chelsea Electricity Supply Company's Order covers the whole parish of Chelsea, a portion of which the Company are now supplying. Direct current is employed, with accumulators; but these are charged with a high-pressure current, and discharge direct at low pressure into the mains. The generating station is situated at Draycot Place, with battery stations at Clabon Mews, Egerton Mews, and Pavilion Road. The Company have a capital of £108,000; and the number of lamps, equivalent to 32-watt lamps, now connected is 19,500.

The Electricity Supply Corporation obtained a Provisional Order in 1889 for supplying the whole of the parish of St. Martin's-in-the-Fields, by direct current, without batteries. The station is placed just off the Strand, and was laid down, some years ago, by Messrs. Gatti, to supply the Adelaide Gallery and the Adelphi Theatre. It is now being extended. At present the plant consists of four boilers, five engines, amounting to 600 indicated horse power, and five Edison-Hopkinson dynamos, each being driven direct from one engine. Callender mains are laid down, in Callender-Webber casing. The number of lamps connected is 8500.

The St. Pancras Vestry have decided to carry out the electric lighting of the parish themselves, and have secured the services of Professor Robinson as their Engineer. The direct current system will be adopted; and a station is now being erected in Stanhope Street, Euston Road, for the supply of the south-west portion of the parish. Particulars of this station have recently been given (*ante*, p. 1005).

The Provisional Order granted to the Notting Hill Electric Lighting Company, includes the district of Notting Hill, which comes within part of the parish of St. Mary Abbots, Kensington. The system is similar to that adopted by the Kensington and Knightsbridge Company. The first generating station, situated off High Street, Kensington, is now approaching completion; the plant consisting of engines and boilers, Crompton dynamos, and Howell batteries. Crompton mains are also laid. The Company's capital is £100,000.

The parliamentary powers of the Metropolitan Electric Supply Company include the large and important districts of Paddington and Marylebone, with part of St. Martin's-in-the-Fields, the Holborn and Strand district, and that of the St. Giles's Board of Works. Various systems are employed by this Company—both the alternating and direct current systems being adopted. The Company have a capital of £500,000; and they are now supplying from four stations. The Whitehall station is a direct-current one, and serves the district after which it is named. The Sardinia Street station contains a complete plant on the Westinghouse alternating-current system. The Manchester Square station is furnished with nine boilers, ten alternators, and four exciters. The Rathbone Place station has plant of a similar kind; there being five boilers, six alternators and engines, and two exciters and engines. The system of distribution from the three latter stations allows each customer to have a duplicate service; thus permitting fresh connections to be made without interrupting the supply on the circuit. The three stations are in communication by trunk mains. The current leaves them at a pressure of 1000 volts; this moderate force being adopted as the number of supply stations reduces the distance to which each cable has to be laid to meet the demand. The total number of lamps connected is 44,598, or about 1486 per mile of main.

Having completed his review of the various central stations, Mr. Bailey proceeded to deal with the private electric lighting plants which have been established in London. He stated that most of the large terminal railway stations are furnished with their own lighting appliances; the largest installation being at Paddington, where the Great Western Railway Company have machinery of 1500 horse power for this purpose. For residences, gas-engines provide the motive power for driving dynamos supplying about 18,000 lamps of 32 watts each; the remainder being driven by steam. It is interesting to note that the "Otto" gas-engine is being largely employed in this way.

With regard to lighting matters, it appears that there are now 85,000 incandescent lamps served from private plants, and 179,000 from companies; making a total of 264,060. All these have been calculated on a basis of 32-watt, or 8-candle power, lamps. Mr. Bailey estimates an increase of about 4000 lamps per week. Of the 50-volt lamps, the 16-candle power ones are employed in the greatest numbers; whereas with the 100-volt lamps the 8-candle power ones are chiefly used, though the 16-candle ones are not much below them. Mr. Bailey furnished some information as to the behaviour of incandescent lamps of 25-candle power, having an efficiency of 3½ watts per candle. Of the lamps working at a pressure of 151 volts, there were 536 renewals —the average life of the lamps being 861 hours; those at 142 volts required 189 renewals, the average life of the lamps being 789 hours; those at 120 volts, 2549 renewals, the average life being 923 hours; and those at 99 volts, 588 renewals, the average life being 1423 hours. The 3862 renewals were necessitated by injury to the globe or fracture of the filament—1229 due to the former, and 2633 to the latter cause. With reference to arc lighting, Mr. Bailey stated that not many more than 1000 lamps are now in use in London, although he thought there was little doubt that rapid progress in this kind of lighting would be made. He regretted that no very marked progress had been made in the efficiency of incandescent lamps, which remains practically what it was five years ago. He pointed out that the progress of electric lighting in the future depends in no small measure on the lamp makers; and as, owing to the expiration of the patents, the manufacture of incandescent lamps would soon be open to all, a standardizing laboratory would be required where not only instruments but lamps could be tested, so that people may know, when they ask for an 8-candle power 100-volt lamp, with or without a guaranteed life of (say) 1000 hours, at an efficiency of 3½ watts per candle, they might get what they had asked for. This, he said, was a question of importance alike to customers and companies—an improved lamp efficiency benefiting the latter by enabling them to increase their lamp connection. He submitted figures showing the cost per annum, at 8d. per unit, of an 8-candle lamp, burning from 182 to 1460 hours per annum—the efficiency ranging from 2 to 4 watts per candle; and he stated in reference thereto that, with ordinary care, the average cost of burning such a lamp for ordinary domestic use need not exceed 10s. per annum. It might be thought that an estimated use of the lamp for only about 200 or 300 hours per annum was very low; but it would be remembered that the electric light need only be used when it was required, as the ease of switching it on and off made people forget their former troubles in looking for matches and turning gas-taps. As to the

wiring of houses, he considered it was here that the greatest progress had been made; for not only is the work done better, but also on more mechanical principles.

In conclusion, Mr. Bailey asked his audience to compare, by the aid of the account he had laid before them, the Metropolis with other cities in regard to its electric lighting; and he left them to judge whether it was so very far behind as some people endeavoured to make out.

At the close of the discussion which followed the paper, the Chairman (Sir F. Bramwell), in proposing a vote of thanks to Mr. Bailey, said he prophesied two years ago that in ten years' time 90 per cent. of all the houses at the West-end of London, of £400 a year rental and upwards, would be lighted by electricity. He now began to think that he had not been sufficiently sanguine, and that he might have mentioned a rental of £300 instead of £400. So long as gas was supplied at 2s. 9d. or 2s. 6d. per 1000 feet, the electric light, until improved in some way—and the only improvement that seemed possible was economy in the lamp—must be a light of luxury; but persons who would pay £300 or £400 a year rent were willing to pay £20, £30, or even £40 more for electric lighting, as compared, not with gas, because many would not use it, but with the other illuminants they employed. After a year's experience in the use of a number of lamps equal to about 114 8-candle lamps, he found the extra cost was between £20 and £25, as compared with the gas, candles, and lamps he used before; and in this he made no allowance for decreased expenditure in cleaning, painting, and matters of that kind, which was undoubtedly considerable. He had also a curious experience, during the summer quarter, of the truth of what Mr. Bailey said about the ease with which the electric light was extinguished and re-lighted. His summer quarter's bill for electric lighting was only a few shillings in excess of the gas bill for the previous year's summer quarter; and he bought no candles or lamp oil—having the electric light all over the house. The reason was simply this: In a dark London basement, even in the summer time, the gas was kept constantly burning. The electric light, on the other hand, was turned out when it was not wanted; and though, no doubt, it was considerably dearer than gas, so much less of it was used, even by the servants, that really it only cost a few shillings more.

THE GAS COALS OF THE UNITED STATES.

At the recent Annual Meeting of the American Gaslight Association, a paper, entitled "The Gas Coals of the United States: Their Geographical and Geological Location and Area, and their Physical Characteristics," was read by Mr. H. C. Adams, of Philadelphia. The author has courteously favoured us with a revised print of his interesting communication; and in view of the fact that, as far as we are aware, this is the first attempt to bring together from various sources all the available information respecting the gas-producing coals of the States; we reproduce the paper practically in its entirety.

In the contemplation of the subject of gas coals and their use, we are struck with the beautiful example they present of the conservation of energy. The sunbeams of thousands upon thousands of years ago, hidden in this form in the bowels of the earth, were apparently lost for ever. But the wise Architect of the Universe does not waste material; and Nature, His handmaiden, though seemingly prodigal, ever works with careful economy of her forces to the desired end. So, after a lapse of ages of a duration almost incomprehensible to our minds, we find the energy and material absorbed in the formation of these coals given out again by the hand of man in the form of light and heat of the present day. Surely this is a monument to design in the planning of the creation—a mark of wise forethought in an omniscient Providence, to whom, when these coals were formed, their use in future ages was part of the stupendous but symmetrical plan that built our world. Is there not much food for thought in that light that makes bright our nights in the long buried but now regenerated sunbeam that centuries ago fell apparently wasted upon the world? And if we incline to philosophize further upon the subject, may we not find that the bright colours, imprisoned deep in this black mass of coal, do, when released, cause the flowers of the infant world to bloom again?

To turn now to the practical aspect of the matter before us, we find that a gas coal is technically and commercially known as one having (say) 30 per cent. of volatile matter, not more than 1 per cent. of sulphur, and a low percentage of ash. But, as a matter of fact, the percentage of volatile matter is not so much the criterion as is the quality. For, as we shall find, a coal lower in volatile matter than another may yet yield a greater quantity of richer gas, and be unqualifiedly superior for gasification. So that, while a lower percentage of sulphur and ash are essential pre-requisites of a good gas coal, the volatile matter is qualified by the question of quality. In a country like America, where so many different grades of coal are used in gas making, it is difficult to precisely define a gas coal, except to say it is such a coal as may be practically used in gasification for the production of illuminating gas. It must, of course, have a certain percentage of volatile matter charged with illuminating hydrocarbons. We may, perhaps, safely draw the line at or about 60 candle-feet, and say that no coal is used in gas making in America that yields much less than this quantity and quality.

The essentials of a good gas coal are a low percentage of ash (say, 5 per cent.) and of sulphur (say, 0·5 per cent.), and a generous share (say, 37 to 40 per cent.) of volatile matter charged with rich illuminating hydrocarbons. And it should yield, under present retort practice, 85 candle-feet to the pound carbonized. It should also be sufficiently dense to bear transportation well, so that, when carried long distances, it may not arrive at its destination largely reduced to slack or fine coal of the consistency of sand; and it should also possess coking qualities that will bring from the retorts, after carbonization, about 60 per cent. of clean, strong, bright coke.

Our theme is readily divisible into two principal parts. The first of these, and the one to which I shall confine my attention in this paper, relates to the geographical and geological location and area of the gas-coal deposits, and their physical characteristics. The second has to do with the relative commercial values of the different coals, and their behaviour and results in gasification; and this is beyond the scope of our present inquiries.

In considering, then, the geological, geographical, and physical aspects of the coals, we must start at the beginning, and take our way with hasty footsteps along the pathway of creation, until we reach the carboniferous jungles that were the source and origin of our subject. Starting with the nebular hypothesis, for want of a better one, and gazing upon our world—a globe of gaseous matter suspended by the laws of gravity in mid-space—we see it cooling, solidifying, and shrinking, until we have a molten mass enveloped with a hardening, cooling, wrinkling crust. Then comes the precipitation of great masses of vapour, and the appearance of a universal ocean reigning supreme. Through this the tightening crust thrusts its wrinkled granite head; and we have the foundation of our Continent. Against these attacks upon its supremacy Old Ocean fiercely fought, and dragged out into its depths great quantities of sedimentary matter, which, thickening as time passed on, placed the first storey upon the house of our habitation. So went on through countless years the building of the world, until at last a great area of dry land in the northern part of our Continent was raised by one of the volcanic throes that characterized that period. Upon this broad area, covering the Northern and Middle, and part of the Southern States, now ripe for planting, were sown the seeds of vegetation that burst forth with incredible luxuriance, and flourished and increased with wonderful prolificacy. Swamps and jungles grew, and fell rotting upon the ground, to be succeeded by others equally productive; and these again returned to earth to make way for their successors. Thus a great depth of vegetable matter was deposited—how great we may perhaps imagine when we consider that it has been estimated that 1200 years' growth of the most luxuriant vegetation of to-day would furnish the material for a coal seam of a thickness of only 6 inches. Now a sudden subsidence of the continent occurred; and over these vegetable deposits the ocean rolled—carrying with it, and piling upon them, masses of sand and mud, which pressed heavily upon the underlying stratum of vegetation, and gradually, but surely, in the slow process of Nature, changed it into coal. The sand and mud in their turn became the superincumbent rocks; and we find we have proceeded one step in the formation of the coal measures. Then another upheaval took place. Again vegetation flourished; again the giant ferns, club-mosses, and reeds spread out their leaves and branches. Then came another sinking of the land—another reign of Old Ocean. Again are the vegetable masses crushed under thousands of tons of sand and mud, and, solidified, preserve to us in the form of coal the carbon which, in the form of carbonic acid, their greedy lungs had sucked from the atmosphere of those days. So, with like repeated processes, vein upon vein of coal is formed, and the coal measures completed. Not, however, in their present area or condition; for subsequently glacier and flood wrought sad havoc in these fields, and the upheavals and disturbances of the unsettled earth-crust distorted and displaced them. But had not these glacial, aqueous, and volcanic disturbances displaced these measures, had they not been cut into or lifted up, had they lain in their original plains, they would have been for ever buried beyond man's reach and knowledge.

The conditions just described characterized what has been aptly termed the Carboniferous period; and it forms, with two small exceptions, the sole source of the coal deposits in our Eastern, Southern, and Middle States. Subsequent like conditions at a later period (the Triassic, but upon a small scale) led to small deposits of coal in Virginia and in North Carolina; but they are of such restricted areas as to be of only local importance. Upon a more extensive plan, however, were the deposits of a still later age, known as the Cretaceous, in which were formed the extensive, but generally inferior, coal-fields of the western part of the United States. The relative ages of these coal-fields are determined by the fossils contained in the measures, which form ready and sure indices. The original deposits were probably all of a bituminous character, varying in kind according to the conditions of pressure and locality. The difference in the quality of the volatile portion is probably due to the varying kinds of vegetation that entered into the composition of the coals in different regions. The physical treatment,

of course, had very much to do with changing the character of coals formed from identical kinds of vegetation.

Now, taking a bird's-eye view of the United States, we see first a long deposit of coal stretching down from New York to Alabama, and almost parallel with the sea coast. This is the extensive Appalachian field—the original and principal one. It lies in Pennsylvania, Ohio, Virginia, West Virginia, Kentucky, Tennessee, and, crossing the north-western corner of Georgia, terminates in the northern part of Alabama. Next we find the middle coal-field, lying principally in Illinois, but extending eastward into Indiana, and southward into Western Kentucky. Then comes the western field of Missouri, Iowa, Nebraska, Kansas, Arkansas, and Indian territory. Finally, we see the great cretaceous deposits of the Western States and territories, whose areas and values have not yet been fully and accurately determined, but which are rich in promise. Through these fields we shall take our way in search of gas coals.

Starting in Pennsylvania, on the Atlantic seaboard, we shall pass southward to the Gulf, and thence again north and westward to the Pacific. At the outset, we must halt for some time in Pennsylvania. The importance of her deposits merits more lengthy consideration at our hands than do those of any other State, for from her coal-beds are drawn the principal gas-coal supplies of the Middle and New England States; and the West, the South, and South-West likewise look here, in some measure, for their supply. Pre-eminent as a coal producer among all the States stands Pennsylvania, whether we regard her vast anthracite formations, peculiar to her own confines, or her vast area of semi-bituminous steam coals; her great bed of world-renowned coking coal, or her magnificent area of standard gas coal. She sent out to the markets of the country in the year 1889 one-half of all the coal shipped over the wide area of the United States; and the next most active of her sister States—Illinois—sent out only one-fifth as much. Blessed as she is with all these various grades of coal, in none of them is she more fortunate than in her gas coal, having regard to the three prime essentials—quality, quantity, and accessibility. In speaking of gas coal, we need consider only at present that pre-eminent bed lying in the south-western corner of the State, adjacent to the city of Pittsburgh, from which it derives its name, and which in area, uniformity, and quality is not approached in the coal-fields of the world. It is spread over the five most south-western counties, and exposed to commercial operation in profusion in all directions by the erosion of the many and noble streams that flow through it. The Alleghany River to the north, the Youghiogheny and Monongahela to the south, joining at Pittsburgh to form the mighty Ohio, are lined with coal-mines along their banks, and expose long lines of virgin coal in the more remote regions, awaiting the expansion of the coal production that will necessitate their development. It seems as though such magnificent water-ways had been made to order through this region, so manifold and so serviceable are they. These streams are wide and shallow; and Nature has to be assisted somewhat to render them navigable with any degree of regularity. Hence, great dams have been built across them to back up the water and give a floating depth to the coal-laden barges and the steamers that tow them. In facilities for transportation by railroad, certainly this region is unapproached; each of the great valleys that form the principal sources of coal supply having a railroad on either side of it. For the eastern market, the great trunk lines, the Pennsylvania Railroad, and the Baltimore and Ohio Railroad, are the carriers. For the western, the Baltimore and Ohio Railroad, the Pennsylvania Company's lines, and the Pittsburgh and Lake Erie Railroad, with its connections, take the bulk of the tonnage. While northward, to the lakes, all these lines, with others of less importance, carry the immense tonnage shipped annually from Cleveland and other ports.

Thanks to the magnificent work of her State Geological Surveys, the gas-coal region of Pennsylvania may be readily defined and described. The measures that confine it belong to the Carboniferous period of the Palaeozoic age. The strata trend in an almost due north-easterly and south-westerly direction; slowly sinking into the earth as they pass to the south-west. Over their north-eastern exposure or crop, the plane of erosion has passed with glacier or flood, cut down the overlapping measures, and exposed the seams of coal to commercial operations, discovering them in their successive geological order. If these measures had been left in their original horizontal planes, the gas coals would have been sunk half a mile below the surface, and would have been immensely more expensive to reach and remove. These carboniferous measures, some 2600 feet thick, comprise within them all the coal-beds, both gas and steam, of Western Pennsylvania. They have been separated by the Pennsylvania Geological Surveys into four divisions: (1) The Upper Barren (about 1100 feet thick), containing several inconsiderable seams of coal, fit only for steam or manufacturing purposes. (2) The Upper Productive (say, 500 feet thick), containing two or three small beds of only local importance as steam coal, and having at their bottom the famous Pittsburgh coal-bed. (3) The Lower Barren measures (say, 600 feet thick), from the Pittsburgh bed to the Mahoning sandstone, and containing no workable coal-beds. (4) The Lower Productive measures (say, 450 feet thick), containing the Freeport and Kittaning coal-beds, which in other parts of the State appear to a limited extent as gas coals, but are of considerable importance and value as steam coals, where they are more readily accessible, and not contiguous to the superior Pittsburgh seam. In the upper series of these coals are frequently deposits of amorphous cannels; of small value, however, for gas making, owing to their large percentage of ash and sulphur. At the base of all these measures lies the well-known Pottsville conglomerate, below which there is no coal to be found, excepting a few small and unimportant seams in the sub-carboniferous measures. But some 2000 feet below the coal measures lie the famous gas "sands"—*i.e.*, sandstones' running from a pebbly conglomerate to a fine, porous sandstone—in whose pores and interstices are confined the natural gas and oil that need only the tap of the drill to bring them rushing to the surface of the earth.

We have seen that, as we descend into the depths of the earth, we find only one considerable vein of gas coal in this locality, and that the Pittsburgh, to which we shall now confine our attention. The seam, which erosion has placed within working reach only in Westmoreland, Washington, Greene, Alleghany, and Fayette Counties—in fact, in the south-western corner of the State—lies in successive shallow basins, with fairly well-defined summits, or "anticlinals," and troughs, or "synclinals," to use the technical but now familiar names. These basins all have the north-east and south-west trend, with a gentle south-westerly dip. The dip or incline of the coal in the several parallel basins is generally gentle from trough to summit, though, owing to the narrowness of the basin, or to some irregularity in the formation, it sometimes rises steeply up the sides. This comparative regularity of dip and trend is of great value in mining; and careful regard must be had for it. The economy of placing a shaft at the bottom of a basin, where it may draw upon coal with the aid of gravity from nearly three quarters the area of a circumscribed circle, does not need lengthy demonstration. The coal-bed has been nearly completely eroded from Northern Alleghany County; while in the eastern part it is left only in isolated patches. In Westmoreland County it runs from a solid body, on the southern part, out to torn and ragged horns projecting to the Conemaugh River, its northern boundary, where we can see how the anticlinals, or uplifted ridges, have been swept bare of coal, leaving it in the sunken troughs of the synclinals. Fayette County, too, has suffered considerably from this erosion; but the vein lies solid and undisturbed in Washington and Greene Counties, where it is deep beneath the sheltering cover of the superincumbent measures. Now of this famous and magnificent vein—*facile princeps* among similar deposits—only a part is gas coal, properly called. As it passes to the eastward, it becomes the famous coking coal of the Connellsville region; and to the south-east, the famous Cumberland steam coal of Maryland. The change in the quality is gradual, but may be fairly well defined.

Roughly speaking, there is no gas coal in this seam in Pennsylvania west of Pittsburgh. As the vein passes to the westward of that point, the percentage of volatile matter decreases, and the structure of the coal changes somewhat; becoming of a more dense character, and what is known as a "block" rather than a gas coal. The richer hydrocarbons seem to have been lost. To the eastward of Pittsburgh there is no gas coal beyond the Irwin basin, of which the town of Irwin (Pa.) defines the trough. Passing beyond that town, over the next crest to the trough of which the town of Greensburg is the centre, we find the coal softer, having lost volatile matter, and fit only for steam coal. The sulphur, too, rises as we go on to the east. In the next, or Connellsville basin, the volatile matter has fallen to 30 per cent., and the seam thickened out to 10 or 11 feet, and entirely changed in aspect. So, also, as we go south-eastward up the Youghiogheny, and southward up the Monongahela, we find the coal thickening, the volatile matter lessening, and the sulphur increasing slightly—the coal gradually passing from a gas to a steam, and thence to the yet softer coking coal. To the south-westward of Pittsburgh the coal changes in character, and becomes more of the nature of a block coal; and soon after crossing the Alleghany County line, it sinks below the upper measures, and becomes, literally and liberally speaking, beneath consideration.

The available Pittsburgh coal-bed in its entirety in Pennsylvania is estimated to cover some 2500 square miles—say, 5,000,000,000 tons of steam and gas coals. In the region to which we have confined the gas coal proper, only a very small percentage has been mined out. Over the whole area lies a vast body of virgin gas coal of the finest quality. Roughly, it may be estimated, allowing 50 per cent. for wasteage, &c., at 1,345,500,000 tons—sufficient to supply the whole United States, grow as it may, for centuries to come. In the gas-coal region proper, the vein is capped by a heavy sandstone, separated from the coal-seam by only a thin seam of shale, which in some places disappears, leaving the sandstone resting upon the coal. The seam proper is in two divisions—the upper and the lower; the total thickness being from 9 to 10 feet. The upper or roof division, being full of impurities in the way of sulphur and fine slate seams, is regarded as unmerchantable, and is left intact. About a foot of fire-clay, called "slate" by the miners, separates the two divisions; and this slate is always removed after mining away the coal beneath. The lower division of the seam, from which is cut the coal that is shipped to market, extends in a clean, solid mass from the "slate" just mentioned, a distance of 3 ft. 6 in. downwards, constituting the "breast" of the coal, as it is called; and here is found the cleanest and best coal of

the seam. Then two small 1-inch bands of slate occur, about 3 or 4 inches apart, that define the portion of the vein where the miner cuts it with his pick on his machine before he "breaks down" the coal, or loosens it from the overlying "slate." Below these slates again is a foot of good coal, which is taken up and shipped. Below that again, separated by a small slate parting, is a foot of bottom coal, as it is called, which, owing to its impurities, is left untouched in the mines. Under the seam is a fine 4-inch band of fire-clay, resting on a shale or limestone. Thus, of a seam from 9 to 10 feet in thickness, only 4 ft. 6 in. to 5 feet is mined out. This vein runs over the whole gas-coal area, with almost identity of structure, and with a wonderful persistence of form.

Physically, the Pittsburgh gas coal is of the highest class of bituminous coals—*i.e.*, the richest in bitumen. In appearance it is black, and shines with a resinous lustre. It is compact, and of sufficient density to "stand up" well, and submit to the rough usage of transportation without crumbling or being ground by attrition to fine powdery coal. In fact, after an incredible amount of tumbling about in the course of shipment and re-shipment, it retains the large lumpy form in which it leaves the mines. It comes from them in large cubical blocks, or nearly of that form, caused by its rectangular cleavage planes. The main plane of cleavage is a vertical one, running regularly through the region nearly north, 25 degrees east, showing a clean, shining, smooth, vertical plane of coal. This cleavage, or "face" as it is called, determines the direction of the driving of entries into the coal; so that in the working places given to the miner to cut the coal—"rooms," as they are called—he may work against and along this cleavage plane, being thus aided in the extraction of the coal. The horizontal fracture is conchoidal; and straited through the coal, in horizontal plane, is always more or less mineral charcoal, in thin seams, with a branch-like structure—showing clearly the woody, fibrous nature of the carbonized substance, representing some vegetation that, for some reason or other, suffered more complete carbonization than the surrounding masses. While generally present in the coal, its bulk is inconsiderable. Thin seams of amorphous cannel appear occasionally running through the centre of the vein. These, however, are of very limited area, and run from 1 to 6 inches in thickness—not sufficient to have any appreciable effect upon the average of the quality of the coal. Occasionally small white scale-like deposits are found on the vertical faces of the coal. These are calcite, or carbonate of lime, probably formed by percolation from superincumbent limestone. The quantity is, however, inconsiderable.

Now, in the matter of the discolorations so frequently noticed, and so often complained of, by gas engineers, they are generally of a nature that does not depreciate the coal in any respect for gas making, or, at the most, so minutely as to be incalculable. Sometimes there will be a fine light-green or grey coating along the face, generally from coals mined below water-level. This, however, is nothing more than silt or pulverized clay, which has found its way down from the superincumbent clays through the partings or cleavages of the coal. Again, through a slight efflorescence of sulphate of iron, a yellowish white stain forms on the coal; but in this case, as in the others, the quantity is so small as not to affect the value of the coal at all. When, however, the coating becomes general and thick, and more particularly is of a rusty or reddish yellow hue, it is almost always an indication that the coal has been mined near the outcrop, and is stained by the drainage of the surface waters through the coal carrying with them the clays or earth that stain the coal. In this case there is generally iridescence on the faces and on all the vertical fractures, caused by the percolation down the faces of thin films of oxide of iron; and the coal becomes rainbow-hued. These coals found near the surfaces are generally freer from sulphur and higher in ash than those mined farther under cover; but their worth as gas coals is considerably diminished, owing to a depreciation in the quantity and character of the yield of gas, due to the action of the continuous flow of the surface waters over them.

We now turn to the impurity of chief moment to the gas maker—*i.e.*, the sulphur. Sulphur we must find, for sulphur in coal is like bark on a tree—it is always there, varying in quantity. It is principally present in combination with iron as iron bisulphide or iron pyrites. This occurs generally in thin brass-like flakes, hard and brittle, with a bright metallic lustre; hence the name for it of "fool's gold." It is also present at times in large flat scales, and again in globular masses of the size and shape of the familiar cobble-stone. The thin flakes or scales are universally distributed through the bed of coal; but, fortunately, the larger stones are of comparatively rare occurrence, and generally lie in well-defined groups or beds. When such beds are met, it is the best mining practice to drive through or around them, and not to attempt to extract the stones as they come to light, and then market the coal. These sulphur stones, when in appreciable quantity, almost always occur in the upper and lower portions of the "breast coal," within well-marked limits. The percentage of sulphur in Pittsburgh gas coal varies from 0·4 to 0·6 per cent.; it should average about 0·5 per cent. in the long run. Experiments have shown that, besides the sulphur in combination with iron as pyrites ($Fe S_2$), there is a varying quantity of free sulphur present—probably about 40 per cent. in the Pittsburgh coal, though this percentage is variable. Experiments did determine, however, that whether sulphur was in the coal free or as pyrites, it made no difference in the percentage volatilized in the process of coking or carbonization. It was found that about 40 per cent. of the sulphur was volatilized in carbonizing; leaving 60 per cent. in the coke. But this percentage of sulphur is precisely that which the residual coke bears to the coal. Thus we come to the important conclusion, verified by experiment, that a coal having a high percentage of sulphur will yield a coke of like high percentage. A coal foul with sulphur, therefore, cannot make a clean coke.

When subjected to heat, the Pittsburgh coal cakes and swells. The volatile matter of the coal, making its way through the intumescing, fusing mass, leaves a series of pores and cells, composed of the carbon of the coal; and if, after the volatile matter is distilled off, the heat be withdrawn, the familiar porous, cellular mass of coke is found. In analysis, the standard Pittsburgh gas coal will, on an average, determine as follows:—

Volatile matter	35 to 40 per cent.
Carbon	54 to 58 ,,
Sulphur	0·6 ,,
Ash	3 to 5 ,,
Water, at 225° Fahr.	1·5 ,,
Coke	60 ,,

A glance over the above analysis suffices to show why this coal ranks as the standard gas coal of the United States; and why other coals are classed as good or bad, according to their approach to it. Here is represented the happy medium—no extraordinary yield of rich gas, with a great evolution of sulphur; no high percentage of volatile matter loaded down with an overbalancing burden of worthless ash. The volatile matter yields a fair return; the coke is plentiful, clean, and merchantable; the sulphur is within limits that admit of its ready and cheap elimination; and the ash, representing the residuum of impurities, is wonderfully low. In fact, if we must have sulphur and ash as necessary evils, here they are to be found at a minimum.

The uniformity of structure and analysis over the immense area of this bed of coal is wonderful. The exhaustion of thousands of acres, the driving of tunnels or entries for miles, into and under the hills through the heart of the seam, bring to daylight, and thence to market, coal that is practically identical with that found at the beginning of operations. This persistence of chemical and physical structure is of no small importance to gas companies. It enables them to predicate certain results in carbonization through a year's work or over a course of years. It gives them a constant as the base of their calculations, without which progress would be impracticable. We need not fear comparison here with our English cousins. Their best gas coals average about the same as our standard coal in volatile matter; in ash they average better than we do—not running much over 2 to 2·5 per cent.; but in sulphur, the far more important consideration, they average about double that of our standard coal. As compared with the provincial gas coals of America, from the Cape Breton district, we stand decidedly superior, both in quantity and quality of gas and also in freedom from sulphur; these coals containing nearly six times as much of the latter impurity. Finally, we excel in greater yield of a superior quality of coke.

The Pittsburgh gas coals first reached the seaboard markets in the early fifties; the coals from the Pennsylvania Railroad main line being the first brought forward. The Youghiogheny coals of the Baltimore and Ohio Railroad came considerably later, owing to the lack of necessary railroad facilities from that district; the railroad from Pittsburgh to Connellsville being then operated as a separate line. When the first attempt was made to sell these coals to the seaboard gas companies, it met with most decided opposition in the prejudice that existed in favour of Newcastle and Pictou coals. The gas engineers of those days could with difficulty be persuaded that any good gas coal could be found in the United States; and they were loth to try experiments with such "unknown quantities." At last, however, after long and persistent efforts on the part of those who had their sale in hand, successive trials were made with the coals, with the never-failing result of their final adoption as the principal raw material of carbonization. They promptly demonstrated their superiority over the provincial coals; and at least their equality with the best of those from Newcastle. They became at once the recognized standard of gas coal; and their consumption has since kept equal pace with the growth of the gas business of the country. The use of these coals in the West and South, and generally in the interior of the country, has been contemporaneous with the establishment and operation of gas companies; no other suitable material offering as a substitute or predecessor.

Leaving the famous Pittsburgh seam, we find only two other gas-coal districts in Pennsylvania to command our attention—(1) the Reynoldsville region of Jefferson County, and (2) the Beaver River region of Beaver County.

In Jefferson County, the lower Freeport vein of coal, which, in investigating the Pittsburgh seam, we found lying some hundreds of feet below it in the lower productive coal measures, rises both in position and quality, and is spread over the whole county, and of workable thickness wherever found; and while it is principally of the composition best fitting it for a steam coal, yet in certain localities it attains the dignity of a gas coal. This seam here lies in parallel troughs with the same north-east and south-west trend that we found in the Pittsburgh coal; and it is of best quality, and principally mined in the Winslow township,

on the eastern edge of the county, in the basin or trough in the centre of which the town of Reynoldsville lies, and to which it gives its name. The coal from this region reaches the markets of the North and North-east, where it is principally consumed by way of the Buffalo, Rochester, and Pittsburgh Railway, and the Western New York and Pennsylvania Railroad. Owing, however, to the incursions of the superior Pittsburgh coal at low prices over competitive routes, the use of this Reynoldsville coal for the manufacture of illuminating gas has practically ceased. Its gas-making properties, however, fully justify its consideration here among the gas coals of Pennsylvania. In physical appearance, the coal is bright, lustrous, and compact; but it has not so deep a resinous lustre as the Pittsburgh, nor is it so dense. Hence, from its greater friability, it does not stand transhipment so well. It has numerous charcoal partings throughout; and it is quite pyritous. The total thickness of the vein here is some 15 feet; but the upper part of it is composed of successive thin strata of coal and fire-clay, and only the bottom member, some 5 to 6 feet in thickness, contains merchantable coal. The following is a fair average analysis of the best of this coal:—

Water at 225°	1·120	per cent.
Volatile matter	33 to 35	,,
Carbon	60 ,, 59	,,
Sulphur	1·27 to 1·43	,,
Ash	3 to 5	,,

The Beaver County region owes its existence to the presence along the valleys of its rivers, at accessible points and in workable quantities and merchantable quality, of the Darlington or Upper Kittaning seam of coal—another of the veins of the Lower Productive measures lifted into prominence through the rise in the measures and the absence of the Pittsburgh coal. This Kittaning seam is very irregular in thickness and character through Beaver County. On an average, however, it runs from 2 to 3 feet thick—not a dimension to recommend it to extensive development, as thin seams of coal are necessarily troublesome and expensive to mine. At Darlington, in Beaver County, it attains a wonderful thickness, and carries with it a thick vein of cannel—a purely local deposit, however. The seam here is at times some 20 feet in thickness. At the bottom is a small bituminous seam 1 ft. 6 in. thick; then come 6 to 12 feet of cannel; and above this again some 6 feet of cannel, gradually passing into a cannel-like shale. Sometimes as much as 12 feet of good cannel have been taken from this deposit; but the average is about 6 feet. The area of the gas coal is found in the Darlington and Beaver townships, in Beaver County, and up along the Big Beaver Valley in Lawrence County. The coal here, however, has met the same fate as that of Jefferson County. The advent of the cheap and superior Pittsburgh coal has ousted it from any market as a coal for the manufacture of illuminating gas. The cannel, of course, continues to be so used; but it, too, suffers from the competition of the superior southern cannels. The cannel is of conchoidal fracture, compact, with dull lustreless appearance. It analyzes well, as shown by the following figures:—

Water	1·160	per cent.
Volatile matter	48·015	,,
Carbon	38·241	,,
Sulphur	0·599	,,
Ash	11·985	,,

The gas coal of this bed is compact and bright, with clear, resinous lustre; in places it is remarkably pure, though generally high in sulphur. An average analysis is as follows:—

Water	1·78	per cent.
Volatile matter	40·00	,,
Carbon	49·00	,,
Sulphur	3·00	,,
Ash	4·06	,,

(To be continued.)

The Belgian Society of Electricians, of which M. Wybauw, who was formerly Superintendent of the Distribution Department of the Brussels Corporation gas undertaking, is President, have organized a series of weekly public lectures by the members, with the view of enabling engineers and others to make themselves acquainted with the latest developments of electrical science.

The Search for Coal in the South-East of England.—According to Sir E. Watkin, M.P., the search for coal at the Channel Tunnel works at Dover is going on favourably; a seam 3ft. 6in. thick having been met with. He thinks that, in addition to coal, the operators have found traces of petroleum, and of that bituminous shale which used to be the only source from which mineral oil was obtained.

The Incorporated Institution of Gas Engineers.—We have received from Mr. J. L. Chapman, Assoc. M. Inst. C.E., the Hon. Secretary of this Institution, which was incorporated by special Licence by the Board of Trade on the 27th of October last, a copy of the Memorandum and Articles of Association as settled—bearing the signatures of Mr. G. C. Trewby, M. Inst. C.E., Mr. A. Colson, M. Inst. C.E., Mr. W. North, Mr. T. May, Assoc. M. Inst. C.E., Mr. J. Methven, Assoc. M. Inst. C.E., Mr. C. C. Carpenter, Assoc. M. Inst. C.E., and Mr. James L. Chapman, Assoc. M. Inst. C.E.; together with a list of the members, 63 in number.

REGISTER OF PATENTS.

Distillation of Coal, Shale, &c.—Parker, T., of Wolverhampton. No. 67; Jan. 2, 1890. [8d.]

The chief object of this invention is to provide a process by which bituminous coal, shale, or the like, containing hydrocarbons capable of being distilled by heat, is distilled at a low temperature; the quantity and value of the solid and liquid volatile derivatives being considerably increased, and a coke produced of an amorphous and porous character, which will readily burn in an open grate or fire-place. The invention applies also generally to the distillation of coal, shale, and the like, as being "a convenient and efficient means of obtaining the volatile portions thereof, apart from the special purpose of producing a coke of the character above described; and it has the great advantage of being applicable to the distillation of a very large mass of coal, shale, or the like as aforesaid, contained within a closed chamber, such as could not be dealt with in a retort or chamber merely externally heated." The material to be treated is placed in a large closed chamber, and raised to, and maintained at, the temperature necessary for the distillation of the volatile portions thereof, by passing into and through its mass heated steam, water gas, or other gas or vapour, which will not support combustion to any material extent. This steam, gas, or vapour may be heated in a manner similar to that employed for heating blast for smelting furnaces, or in other convenient manner; and the products of distillation are collected and dealt with in the same way as the volatile products from a coal-gas retort. The non-condensible products resulting from the distillation may be utilized in conveying heat to the material under process of distillation; such products being used over and over again if desired. Also, if required, the combustible gases, or a portion thereof, resulting from such distillation may be employed to heat the steam, gas, or vapour which is used to impart the desired temperature to the material under process of distillation, or the heated non-combustible gases resulting from such ignition may be utilized in imparting heat direct to the material. The combustible gases also may be used for the purpose of illumination.

Fig. 1.

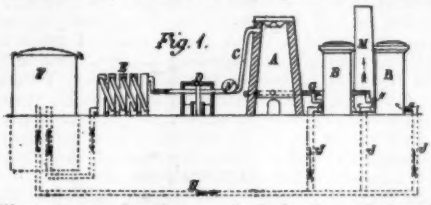


Fig. 1 illustrates an elevation, partly in section, of plant in which products of the distillation are utilized as the medium for conveying heat to the material under process of distillation; Cowper or other regenerative stoves being employed to raise such products to the required temperature. A is the chamber in which the distillation is effected; B, the Cowper or other stoves; and C, the outlet-pipe, which conveys the volatile products of distillation away from the upper portion of the chamber. N is an exhauster; D, a tar-pit; E, condensers; and F, a gasholder—all of the character of those used in ordinary gas-works. G is the main from the stoves to the tuyeres, which enter the chamber A; and H is a pipe from the gasholder to branches J, which lead up to the entrance-valves to the stoves. The products of distillation, passing away through the tube C, are conveyed, through the tar pit D, and condensers E, to the holder F, and travel from thence to the stoves. The gas is burnt in the one stove, with a suitable admixture of air, until the temperature of such stove is sufficiently raised; and at the same time the gas is simply heated in the other stove, and passes thence into the chamber. The action is reversed from time to time; each stove being first heated by combustion of the gases, and then used to raise the temperature of a further supply, which flows thence into the chamber. The operation is controlled by valves, so that, as one stove is being heated by the combustion of the gases on their way to the chimney M, the other stove is heating the gases which are passing to the chamber. The chamber is close-topped, and the material is fed in through a cup and cone. The coke is drawn out through a door in the bottom.

Fig. 2.

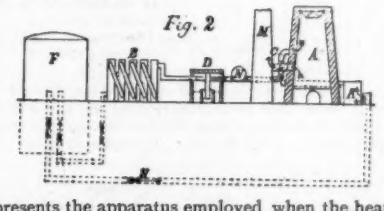


Fig. 2 represents the apparatus employed when the heat is supplied direct to the material under process of distillation by the combustion of the volatile gases given off during such process. In this case also an exhauster N, tar pit D, condensers E, and gasholder F are used. An outlet L, for the passage of the spent gases to the chimney M, is formed at a height of a few feet above the bottom of the furnace; and an outlet C, for carrying off the hydrocarbons and other products of distillation to the gasholder, is arranged a short distance (say, 3 or 4 feet) above the outlet for the spent gases. The gases from the holder F pass into a combustion chamber K, in which they are ignited with a suitable admixture of air, and pass from thence to the tuyeres into the chamber. These gases, after flowing vertically through a portion only of the mass of the material under process of distillation, pass out through L into the chimney. The portion of the material thus heated causes also the heating by conduction of the material above it; and the hydrocarbons and other volatile products resulting from the distillation collect, in consequence of their low specific gravity, in the upper part of the chamber, and pass off through the outlet C to the holder.

When it is desired to produce a coke of the amorphous character

above described, a low temperature from about 500° to 800° C., or preferably (say) from 550° to 650° C., should be employed for effecting the distillation of the coal. But when it is not required to produce such coke, the distillation may be effected under a high temperature; and in such case the process may be advantageously used in the production of coal gas, in substitution for the process adopted in ordinary gas-works—of distilling by the application of heat externally to the retort.

Washing Gas.—Horn, W. W.; a communication from C. W. Jarrell, of Shelby, U.S.A. No. 788; Jan. 15, 1890. [8d.]

This invention relates to improvements in apparatus to be used for the purification of furnace gases, in which the gas is made to pass through a flue or tank, while a spray of water descends to the bottom of the tank through the gas. The invention also has for its object to provide apparatus for the purification of gases in which two sets of inclined water-shelves are so arranged relatively to each other that the gas is caused to take a zig-zag course in its passage upward, and the spray of water descending from above is broken in its fall, so that the gas is more thoroughly split up, and the globules or vesicles are broken by the attrition, and the foreign matters are released, and caused to descend to the bottom of the apparatus.

Gas-Stoves.—Carrington, J. H., of New York. No. 1089; Jan. 21, 1890. [8d.]

This invention consists of a stove, the body of which is composed of perforated metal, with a cone-shaped shell or dome formed of transparent material placed inside, so as to reflect the light from below through the body of the stove from all sides.

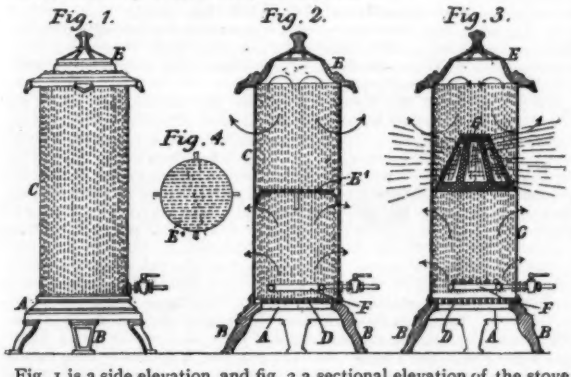


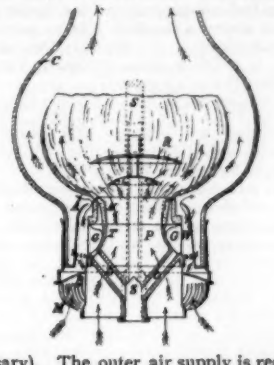
Fig. 1 is a side elevation, and fig. 2 a sectional elevation of the stove. Fig. 3 is a vertical section, showing the reflector; and fig. 4 is a view of the deflecting plate.

The base of the stove A is provided with legs B, and flanged to receive the lower end of the body C and the perforated bottom plate D. The body is of foraminated metal (sheet iron, preferably). The perforations are, by preference, small and close together; from 100 to 300 perforations to the square inch producing the best results. The top E is without apertures, and serves to intercept the rising currents of heated air, and cause them to be deflected downwards and outwards; or a reflector G (as fig. 3) may be used. The burner F is located at, or near, the base of the stove; and for high stoves, a perforated plate E¹ is placed about centrally, so as to deflect the heat, and throw it out more at the base of the stove, as well as intercept any upward draughts. Within the casing, and supported adjustably at various heights if desired, is a transparent shell G, shaped either like a truncated cone or a rounded dome, and open top and bottom. The shell is constructed something after the manner of an illuminated lamp shade, of mica, porcelain, or coloured glass, or of fine gauze wire with illuminated panels, so that, as the light shines upward from the burner, it strikes the inner wall of the shell, and the whole becomes illuminated. It also serves an important mechanical function; for, as the hot currents of air ascending from the burner reach the shell, the contracted passage through it serves, in a measure, to check the upward passage of air, and compels a portion of the heated and expanded air to be forced through the perforations of the outer casing below the cone and at a point nearer the floor. The remaining portions of hot air pass through the opening at the top of the cone; and, striking the cap E, are deflected through the meshes or perforations of the outer casing above the cone. In this way, the stove is made to heat uniformly from the bottom to the top; an excessive heat at the top is avoided; and the heat is kept down in the lower portion of the room, where it does the most good.

Gas-Burners.—Hemingway, W., of Walham Green, London. No. 1184; Jan. 22, 1890. [8d.]

This invention consists of improvements on patent No. 3717 of 1885. The body of the burner is built up of the trunk T, the nipple N, and the outer shell. The base constitutes the outer portion M; and the air-cone A. The trunk of the burner consists of a ring-shaped casting, which forms the wall of the central or internal air conduit P, as well as the interior wall of the gas-chamber G. It is connected by the gas-ducts D to the stem S, which forms the service to connect the burner with the pendant or bracket.

In longitudinal section, the internal air-conduit P is much wider at the base than the upper part; thus increasing the velocity of the air, and furnishing a much larger supply than would be the case if the passage were nearly or wholly parallel. The outer shell or wall of the annular gas-chamber is made of brass; its top edge being flanged to hold the nipple N in position. The lower part is turned over, so as to form the base M, or the bottom edge may also be flanged, turned over, or screwed so as to carry the base. The middle portion has a groove or thread in it, to correspond to the trunk T, to fix it thereto. The nipple N, being in direct contact with the flame, is preferably made of some refractory material—such as enamel, kaolin, or steatite; and it is held in position by a flange on the outer shell or wall—the bottom edge being supported by lugs on the casting T. Near the outlet of the central air-conduit, and carried by a small rod, is placed the main disc or deflector R, for the purpose of directing the air current on emerging from the conduit. The subsidiary disc or diffuser (below the main one) is for the purpose of better regulating the diffusion of air than when one deflector only is used; and it is more or less perforated



(though not necessary). The outer air supply is regulated by limiting the perforations or air spaces through the base M, by means of baffle-plates B, and by the diameter of the outlet of the air-cone A. At or near the lower edge of the air-cone, perforations are made, to allow a current of air to flow between the flame and the chimney C, so as to reduce the temperature of the chimney, and save breakages. The lower ledge of the air-cone forms a gallery to carry the chimney C, which is held thereto by springs.

APPLICATIONS FOR LETTERS PATENT.

20,449.—Donnithorne, E. G. M., "Improvements in gas-engines." Dec. 15.

20,454.—Hatton, E., "Improvements in gas lighting apparatus." Dec. 16.

20,489.—Greenhill, M. C., "Improvements in and relating to liquid-meters." Dec. 16.

20,566.—Clark, A. W., jun. "Improvements in gas-lamps." Dec. 17.

20,606.—Regnault, R. J. M., "Improvements in gas furnaces for use in glass and other works." Dec. 17.

20,752.—Lewes, V. B., "Improvements in the manufacture of hydrogen gas, or a mixture of hydrogen and carbon monoxide, and apparatus therefor." Dec. 19.

20,826.—Barlow, J., "Improvements in gas-engines." Dec. 20.

Shocking Accident at the New Wortley Gas-Works of the Leeds Corporation.—A sad accident occurred last Tuesday at the New Wortley gas-works of the Leeds Corporation, by which a married man, named Edward Gartside, aged 44, met with his death. He was engaged in driving a locomotive, drawing trucks of coal from the railway sidings into the yard. By some accident with the points, the engine, instead of turning off to ascend an incline to an overhead railway, continued on the level rails, and came into collision with a heavy stationary coal truck standing on the line. The buffers of the truck dashed through the "weather-board," forcing the sheet of iron in upon Gartside, and pinning him against the machinery. At the same time the gauge-glass was fractured and the steam-cock broken off. The steam was set at liberty, and commenced to pour upon the unfortunate man. In addition to this, the "weather-board" had been forced up from the floor behind, and Gartside's leg was thrust through the aperture thus made, and there firmly held. The workmen rushed in amongst the steam which enveloped the engine, and did their best to wrench away the ironwork at the side. This, however, they were unable to do; and the driver was compelled to remain where he was for nearly a quarter of an hour. When the poor fellow was released, he was found to be dead. The shunter, Fred Walker, was on the engine at the time, and was severely injured. An inquest on the body of Gartside was opened in the evening; but after evidence as to identification had been taken, it was adjourned to the 15th prox.

The "Electrician" on Ventilation with Gas and Electric Lighting.—Our contemporary the *Electrician* reproduced, in their issue for the 19th inst., the article on "Gas and Electric Lighting and Ventilation" which appeared in the Journal for the 16th inst., and commented thereon as follows: "Electrical engineers would do well to glance occasionally at some of the journals devoted to the gas industry. They will find an inveterate opposition to electric lighting, as may naturally be expected; but, on rare occasions, among the criticisms (which, after all, show a much more creditable knowledge of the subject than is exhibited by the daily press), they may find such an article as that which we reproduce in this issue. The ventilating power of gas, if we may use the expression, is merely that of the furnace in the upcast shaft of a mine. It depends quite as much upon the shaft as on the furnace; the former may, indeed, be said to be more essential than the latter. Practically, the *desideratum* is a sun-light with ample flue. If electric light be used in the sunlight, it would be well to put a few gas-burners immediately above them, within the flue; and as their light is not wanted, and their radiant heat is objectionable, Bunsen burners would be better—in fact, a good ordinary gas-fire might be used. The belittling of the value of oxygen, or of its consumption, is carried rather too far by the writer of the article to which we have alluded. It is true that the occupants of a room need fresh air; but a gas-burner needs seven times as much. The remarks about the hall of the Society of Arts are none too strong; and for many years the ventilation of the theatre of the Royal Institution was a standing disgrace."

CORRESPONDENCE.

[We are not responsible for the opinions expressed by correspondents.]

Innovation upon the Sliding Scale.

SIR,—The innovation upon the sliding scale in the Aldershot Order, alluded to in the last JOURNAL, is very easily explained. It can scarcely indeed be called an innovation; for, apart from the 3s. rate, it is in other respects almost a novelty. The 5s. per cent. is the sliding scale universally granted upon gas capital; the 3s. per cent. of the Aldershot Company is a sliding scale applied to the combined capital of an existing Gas and Water Company.

I am aware that, accompanied by conditions as to the separation of capital and accounts, the 5s. rate has been allowed to one or two new gas and water companies; but, except in the case of Bournemouth, I do not know of any precedent of its application to the *combined* capital of any other established company of this kind.

This precedent in our favour was, however, disallowed us by the Board of Trade, on the plea of having now become ancient history; but they offered the usual rate with a 3s. 6d. initial price, if we agreed to separate the gas and water capitals and accounts—more or less upon the lines of the recent Canterbury Act. This, for ample reasons, the Company refused to do; and we were proceeding with the Order without reference to this obstacle, when the Local Board changed their opposition, and intimated that the adoption of a sliding scale was essential to their consent. As it had been admitted that the proportions of gas and water capitals were respectively about 3-5ths and 2-5ths of the whole, the suggestion was then made by a member of the Local Board that, instead of separating the capital, the percentage of the scale should be reduced, so as to be to the 5s. rate in the proportion of the gas capital to the whole; and that it should be applicable to the original capital employed in both gas and water undertakings.

I do not say that this is by any means a perfect principle, or that it would be fair in all circumstances; because the sliding scale is worked solely in reference to the price of gas, and should be restricted to gas. But in our case it appeared to come to the same result, practically, as if we had done so on the higher rate; and, accompanied by a 3s. 8d. instead of 3s. 6d. initial price, it was accepted as a reasonable solution of the difficulty.

A proper understanding of the point of distinction which I have thus endeavoured to explain, will show that no precedent is thus established for a reduction of the 5s. rate to gas companies which are not also water companies; and I hope this letter will satisfy you that the Directors were not influenced solely by considerations of the moment, as the concluding part of your article suggests. Indeed, I cannot help expressing surprise that such censure should have been considered at all warranted; as, although I have not the Order before me, I am almost certain that if carefully read over, it is self-explanatory of nearly all I have here stated.

Burnbrae, N.B., Dec. 26, 1890. A. F. WILSON.

[Our remarks were certainly not intended as a censure upon the Directors of the Aldershot Company; but we are glad to have Mr. Wilson's explanation, which elucidates the point presented merely as a bald statement of fact in the Board of Trade report.—ED. J. G. L.]

The Bowman Oxygen Company.

SIR,—I should feel much obliged if you will kindly publish in your valuable JOURNAL the enclosed letter, copy of which has been sent to the Directors of Bowman's Oxygen Lighting Company, Limited, in reference to a prospectus of that Company now before the public. Mine to the Company's Directors will explain itself. I would not have troubled you, only I think the public should be made aware that the prospectus issued by Bowman's Oxygen Lighting Company, Limited, is in part an infringement on our patents. H. M. CALDWELL.

3, *New North Road, Huddersfield, Dec. 26, 1890.*

[ENCLOSURE.]

Sir Christopher R. Lighton, Bart.,
Director of Bowman's Oxygen Lighting Company, Limited.

Sir,—Seeing your name on a prospectus entitled "Bowman's Oxygen Lighting Company, Limited," I beg to call your attention to the following facts: That the Hydro-Oxy Gas Proprietory, Limited, of Sydney, N.S.W., have purchased from Edwin Tatham, of Sydney, the sole right to use his patents all over the world. Thirty-three patents have been granted to the said Edwin Tatham in different countries; three of these patents being for Great Britain. Part of the claims granted are for light, heat, and power, and give the patentee the sole right to the use of oxygen in combination with coal gas, hydrocarbon or oil gas, and water gas. Mr. Bowman may not have been aware that the patents for the above purpose had been granted to Edwin Tatham when he applied for his; but a long notice on our patents appeared in the JOURNAL OF GAS LIGHTING many months ago, and a copy of that JOURNAL shows the registration of Bowman's Oxygen Lighting Company and the claims made by Mr. Bowman, part of which claims had been granted to Edwin Tatham in three different patents. I do not wish to write to the JOURNAL calling attention to our patents being made use of in your prospectus; so I thought that, by writing you, feeling sure that you could not be aware of the existence of the Tatham patents, you would bring the matter before your co-Directors.

In conclusion, though I much regret it, I beg to say that on any infringement of Edwin Tatham's patents now owned by the Hydro-Oxy Proprietory Company, your Company will be served by our Solicitors with an injunction forthwith; and we shall hold the Directors of your Company liable for any loss sustained, by the publication of the first and second clauses in your prospectus. I am sending a copy of this to your co-Directors.

(Signed) H. M. CALDWELL, Representative of
The Hydro-Oxy Gas Company, Limited, of Sydney.

3, *New North Road, Huddersfield, Dec. 14, 1890.*

Breach of Contract by a Gas Stoker at Swansea.—At the Swansea Police Court last Tuesday week, a stoker named Bone was summoned by the Gas Company for leaving work without notice. The Stipendiary gave a decision for the amount claimed (£1 18s.), and costs.

MISCELLANEOUS NEWS.

THE LONDON COAL DUES AND THE PRICE OF COAL.

An interesting report has just been issued by the Coal, Corn, and Finance Committee of the Corporation of London, to whom was recently referred the question: "What has been the result in the way of fluctuation or alteration of the price of coal in London since the abolition of the coal dues?" The Committee first of all refer to the action taken by the Corporation and the Metropolitan Board of Works in relation to the renewal of the dues, and to the fierce opposition which these bodies met in their endeavours to obtain this renewal. The dues, they proceed to say, had reached their lowest figure when they were abolished. They had existed in London in one form or another for more than 600 years, and were almost the oldest taxes in the country. In 1832 they were settled at 13d. per ton, at which rate they remained till their abolition. From 1832 they had been applied to Metropolitan municipal purposes in abatement of Metropolitan rates. The opposition to the renewal of the dues was started, and mainly kept alive, by the exertions of those who were interested in maintaining the price of coal. Londoners had been accustomed from time immemorial to pay the dues, and a large proportion of them were unaware that they contributed indirectly to the vast improvements which were gradually transforming the streets and thoroughfares, freeing the bridges, and providing open spaces for the Metropolis. The first elections to the London County Council, owing to the apathy of the electors, resulted in the return of a majority of untried administrators, pledged to theoretical views. These, before they were fully constituted or had any experience of the subjects with which they would have to deal, even refused to send the matter to a Committee for investigation, but threw away a revenue of upwards of £500,000 a year, regardless of the consequences to their constituents, on whom thus devolved an additional rating of 4d. in the pound.

Having sketched the means by which the tax was abolished, the Committee proceed to notice the fiscal and financial results of the abolition. They say that during the month of July coal on the market is generally at its lowest price; but within a few days of the duty of 9d. per ton being taken off in 1889, the price rose from 15s. 2d. to 16s. 8d. per ton. In 1887 the price was 13s. 11d. per ton; and in 1888, 13s. 9d. This year the price has risen to 18s. 9d. The retail price shows no diminution. Large quantities of coal are sold to the poor in fractions of a ton. No returns are published of these prices; but the statement is made that, in the poorer parts of London, the prices per hundredweight, as exhibited on the carts, exceed by at least 2d. to 3d. the sums charged before the abolition of the dues. The latter figure represents 5s. per ton. Inquiries from the Gas Companies elicited the fact that, whereas at the time of the remission of the coal dues the price of gas coal delivered in the Thames was 10s. per ton, it suddenly rose to, and continues at 16s. per ton; the coal-owner not only placing his hand on the entire amount of the dues, but also adding some 33 per cent. to the price. No abnormal increase in the quantity of coal imported into London followed the abolition of the duty, as predicted by Lord Randolph Churchill. The Committee assert that the amount lost to the finances of the London County Council by this mistaken and uncalled-for disturbance of the trade was upwards of £525,000 per annum at the present rate of consumption of coal in London (9,709,000 tons annually). To raise this sum on the present rateable value of the County of London (£31,244,495) would necessitate an addition to the rates of 4·032d. in the pound. This unavoidable increase in the rates is, of course, irrespective of the augmented price of coal to the consumer. The price of best coal on the market before the abolition of the dues was, at this period of the year, in 1887, 15s. 5d.; in 1888, 15s. 11d.; whereas in 1889 (after the dues were abolished), it was 21s. 8d., and is now 19s. 6d. Some part of the increase must, of course, be set down to strikes; but the disturbance of the trade consequent on the repeal of the dues is undoubtedly responsible for the larger portion of the difference. A schedule to the report contains a list of Metropolitan improvements and public works carried out by means of the coal dues. All districts of the Metropolis have, it is stated, been benefited more or less by the expenditure of the money thus laid out; while Middlesex, Surrey, Kent, and Essex have been relieved of county rates which, but for the coal dues, would have been levied upon them according to law, for providing county communications across the Rivers Thames and Lea.

THE SALFORD CORPORATION GAS COMMITTEE AND THE OUT-TOWNSHIPS.

For many years past the inhabitants in the outlying districts of Salford have been agitating for the abolition of the differential rate charged for gas by the Corporation Gas Committee; but success has not attended their efforts. One or two of the local authorities, however, have determined to make another struggle to secure "justice," by opposing the application of the Corporation in the present session of Parliament for further powers.

The Eccles Local Board, last week, had under consideration a resolution which declared that it was expedient, in the interests of the ratepayers, that the Bill promoted by the Salford Corporation, to alter and enlarge their borrowing powers, and to enable them to apply their corporate funds and any moneys which they are already authorized to borrow to the purposes of the Bill, and to charge those moneys upon the borough rate, borough fund, gas and water undertakings, &c., should be opposed. The Chairman (Mr. R. Spary) remarked that for some years the greatest dissatisfaction had been felt at the way in which the district had been treated by the Salford Corporation in relation to the gas supply. Deputations had gone to the Gas Committee, and had received promises; but, he was sorry to say, they had not been kept. It seemed, therefore, that the only way of securing justice would be by opposing in Parliament, when the necessities of the Corporation compelled them to seek further powers in connection with the gas supply.

It was very objectionable to have to oppose another local authority; and he was sorry that the Corporation would not do justice to them voluntarily. Similar action to that proposed had been taken by the out-districts of Oldham, and the Corporation of that borough had been compelled by Parliament to abolish the differential rate; to keep the gas profits within 6 per cent., out of which they had to repay the money borrowed for the purpose of increasing the gas supply; and to render accounts to the out-townships. He thought the result of the notice of opposition in their own case would be that the Salford Gas Committee, which had been reconstituted, would consider the matter fairly and reasonably. If they would not, the ratepayers of the Eccles district would be put to a fairly considerable expense; but he believed the result would be worth the outlay. Mr. Mellor said he seconded the motion with feelings of regret that it was necessary to take what seemed to be unneighbourly action. It was no secret that the Board would be earnestly supported in its opposition by a neighbouring authority. After a short discussion, the resolution was carried unanimously. It is understood that, in the event of the Board continuing its opposition, their representatives will tell the story of the gas frauds to the Parliamentary Committee which considers the Salford Bill, and will complain that the Corporation have devoted from £50,000 to £60,000 to borough purposes as if it were ascertained profit, instead of applying it to the maintenance and extension of the gas-works. It is also in contemplation to apply to Parliament next year for a Bill to enable the Board to themselves supply the district with gas.

On Tuesday the Swinton and Pendlebury Local Board held a special meeting to consider the advisability of opposing the Bill. The Clerk stated that, at a conference, the Eccles and Swinton Local Boards had decided to jointly oppose Salford in their present Bill, with the view of securing the abolition of the differential rate, and the fixing of a limit to the percentage of the gas profits made by Salford, and to compel the Gas Committee to furnish Eccles and Swinton annually with a statement of its expenditure and receipts in connection with the manufacture and supply of gas to the out-districts. Salford would probably, in the first instance, seek a Provisional Order; and in that case the Local Government Board would cause a local inquiry to be held, and Eccles and Swinton could send representatives to oppose the granting of the Order. If they failed at the inquiry, they could oppose the Bill before the House of Commons. It was remarked by a member that, by the abolition of the differential rate, private gas consumers in Swinton and Pendlebury would save from £1200 to £1500 per annum. A resolution to oppose the Bill was carried with only one dissentient.

GREENOCK CORPORATION GAS SUPPLY.

Inadequate Storeage and Deficient Pressure of Gas.

At the last Meeting of the Greenock Police Board, the members were engaged in the consideration of the Gas Committee's minutes, in which it was stated that railway connection with the gas-works at Inchgreen had been made by the Glasgow and South-Western Railway Company, which was of such a character as to be beneficial to the Gas Trust probably to the extent of about £700 per annum. This new line of railway was inspected and formally opened some days ago. Another item brought up at the same meeting was a letter from the Gas Engineer (Mr. S. Stewart). In it he called the attention of the Gas Committee to the necessity of additional gasholder accommodation, in consequence of the present limited amount of storeage. He said he had frequently been unable to keep up an efficient pressure, and that consequently the supply in the early part of the evening led to complaints as to the quality of the gas. The outlay for a new holder would be considerable (probably at least £5000); but even though this was so, he was sure that the profit upon the increased consumption they would then have would be more than sufficient to enable the works to pay off the outlay by instalments in a few years. When moving the adoption of the minutes, Bailie Erskine, Convener of the Committee, referred to the fact that the question of additional holder accommodation had been before them a year ago, when it was considered advisable to postpone further consideration of it. Now it had forced itself upon them; and they would at length require to meet the difficulty, notwithstanding the cost of £5000. There had been, he went on to say, a considerable number of complaints of late as to the bad quality and the pressure of the gas—deficiencies which, as stated in Mr. Stewart's letter, were due to the insufficiency of the storeage at Inchgreen. Consequently, they required to look at what was necessary to be done in order to obviate those complaints. He further stated that the matter had been remitted to a Sub-Committee; and he trusted that, at the next meeting of the Board, such a report would be submitted as would enable them to decide at once what action should be taken. In the course of the discussion which followed, Dr. Cluckie remarked that he was not aware till then that the storeage and pressure of the gas had anything to do with its illuminating power. Then Captain Clink said that, whether or not the fault was due to quality or pressure of the gas, they really might as well be without any lights at all. He was tired of complaining. Treasurer Innes pointed out that the complaints from the West-end were no more numerous than those from the East-end, where some people had gone the length of purchasing candles to assist the gas. Bailie M'Onie, a former Convener of the Gas Committee, said that the bad quality of the gas which had been complained of by so many people, and perhaps not without a good deal of reason, must arise from one of two causes—bad gas or want of pressure. They might have the best gas in the world, but if they had not a good pressure they would not have a good light. In answer to the Provost, Bailie M'Onie said he was of opinion that a new gasholder would give an increased pressure. It was only the great cost involved that made him speak less on that matter than he otherwise would have done. Ex-Bailie Ramsay said he would support the proposal to obtain a new gasholder if it would improve the illuminating power of Greenock gas. Bailie Erskine, in reply, said that the complaints alluded to only pointed to the necessity of considering carefully the important question before them—viz., that of providing a new holder. The tank for the holder was prepared, at an outlay of about £4000, some years ago. The matter then dropped.

THE LANCASTER CORPORATION GAS-WORKS.

By the courtesy of Mr. C. Armitage, the Engineer of the Lancaster Corporation Gas Department, the *Lancaster Gazette* was enabled, in a recent edition, to give its readers a clearly-written account of the process of gas-making and a description of the local gas-works; and it will be interesting to extract therefrom a few particulars concerning these well-appointed works. The article commences by tracing the history of coal gas from the experiments of Dr. Clayton about 1739, on to the days of Murdoch, and to the present time; and then the writer turns his attention to the local gas supply. He states that up to 1819 the Corporation lit up the thoroughfares of Lancaster with lamps; but in that year a meeting resolved that the inhabitants of each street should light their own lamps. In 1820 and 1821, the resolution obtained; but in the latter year many of the inhabitants refused to subscribe to the cost. On Sept. 28, 1825, a meeting was held at the Town Hall, the then Mayor (Mr. Leonard Redmayne) in the chair, when it was resolved to form a Company to supply the town with gas. The capital, £8000 was proposed to be raised in 400 shares of £20 each. The shares were taken up in a very short time; and the works were erected in 1829, but were rebuilt in 1859. On Feb. 24, 1827, the streets were illuminated with gas for the first time. Proceeding to describe the present works, the writer states that the retort-house is 150 feet in length, and 90 feet in width, and is covered with an iron roof. A siding is laid on each side of the benches, and the coal and cannel are brought from the Quay siding, which is connected with the London and North-Western Railway system, and are deposited in front of the retorts. The number of retorts is 140; they are Ω-shaped, 20 in. by 15 in., and 9 ft. 6 in. in length, and are capable of producing 750,000 cubic feet of gas per diem. A foul main (550 feet in length and 18 inches in diameter) runs round the interior of the retort-house. An annullar condenser is employed, which was erected, from Mr. Armitage's design, in 1888; and consists of seven columns—each being 42 inches in diameter and 30 feet in height, and fitted with twelve diagonal pipes 12 inches in diameter. There are two of Beale's rotary exhausters, worked by an engine of 8 horse-power (nominal). For cleansing purposes one of Mann and Walker's tower scrubbers is used, filled with boards ¾ inch in thickness and 6 inches deep, and placed ¾ inch apart; also one of Laycock and Clapham's washers. In the purifying-house, there are four lime purifiers, 18 ft. by 12 ft., which were erected by Messrs. C. and W. Walker; and also another set of oxide of iron boxes, each 18 ft. by 16 ft., by 5 ft. deep, which were constructed, from Mr. Armitage's plans, by Messrs. R. Dempster and Sons, Limited, of Elland, in 1888. The station meter was erected by Mr. G. Newton, of Oldham, in 1876; and is capable of passing about 30,000 cubic feet of gas per hour. The gasholders are three in number. The smaller one is 65 feet in diameter and 14 feet in depth, and is capable of storing 50,000 cubic feet of gas. The medium holder is 100 feet in diameter and 20 feet in depth, and is capable of storing 150,000 cubic feet of gas. The large holder has three lifts, and takes the place of a very small one abolished in 1880. The holders bear the names of members of the Royal family—the large one being called Victoria; the medium one, Edward; and the small one, Albert. There are six valves for the inlets and outlets of the holders, also a governor for regulating the supply of gas to the town through two 15-inch trunk mains, one of which has only just been completed. It may here be remarked that the Corporation are only compelled to supply gas equal to 14 sperm candles; and it is tested by an Evans bar photometer. The tar and ammonia works are also referred to in the article; but as the results obtained from them were fully set out in our report of the visit of the Manchester District Institution of Gas Engineers to Lancaster at the end of August last (see *ante*, p. 495), we need not notice them here. Before concluding his article, the writer states that, when the gas-works were purchased by the Corporation in 1879, the gas manufactured was 53 million cubic feet; and the price at that time was 4s. 6d. per 1000 feet—an allowance being made of 12½ per cent. to consumers when the consumption reached 150,000 cubic feet per annum, and 8 per cent. rebate was granted to consumers who used under that quantity. The Company had £30,000 of 10 per cent. stock fully-paid up, and £7000 of loan capital. The Corporation paid £80,000 for the £30,000 10 per cent. fully paid up shares, and took over a mortgage of £7000; so that altogether they paid £87,000. The amount of capital expended on capital account at the present time is £101,124; the increase being due principally to the new gasholder and tank erected in the year 1881, and since considerably enlarged. (This holder was described in detail in the JOURNAL for the 18th ult., p. 1053.) Since 1883 nothing whatever has been added to capital account. The quantity of coal and cannel carbonized in 1890 represents 12,000 tons; and the amount of gas made has reached 120 million cubic feet. The price of gas is now 2s. 3d. per 1000 cubic feet net; no meter-rents are charged, these having been abolished in 1889. The meter-rents were equal, on an average, to about 1½d. per 1000 feet of gas. The price of gas is therefore only one-half of what if was when the Gas Company possessed the works.

An Unremunerative Gas Undertaking.—The shareholders of the Folkingham Gas Company, Limited, have determined to close their works on the 6th of April next, and effect a disposal of the plant. The Company—which is one of the oldest in South Lincolnshire—has, in recent years, proved unremunerative, owing to a decrease in the consumption of gas. The price charged was 5s. 10d. per 1000 feet.

The Staff of the Liverpool Corporation Water Department.—In connection with the re-arrangement of the staff of the Liverpool Corporation Water Department a short time since, a special meeting of the Water Committee was held last Wednesday week for the purpose of considering the position of affairs in regard to the Vyrnwy water-works. After considerable discussion, it was resolved that the Council be recommended to retain the services of Mr. Deacon as Engineer of these works for a further term of six months. This will involve the postponement of the new arrangement, which, under ordinary circumstances, would have come into operation on the expiration of the present year. As the different works are completed, Mr. Parry will take charge of them.

METROPOLIS WATER SUPPLY.

The London County Council and the Water Question.

In the course of the report of the proceedings at a recent meeting of the London County Council which appeared in the JOURNAL for the 16th inst., reference was made to a Memorandum on the London Water Supply which had been prepared by the Vice-Chairman (Sir T. Farrer) for the use of the Special Committee of the Council who have this matter in hand. The following is an abstract of the document, some points of which have been already noticed in our editorial columns.

The first paragraph sets forth that the Special Committee, in conjunction with the Parliamentary Committee, were lately authorized to submit to Parliament the views of the Council on any Bills relating to the water supply of London which might be brought in during the present session. It appeared to the writer, however, that the subject might raise questions which could not be adequately settled by the Bills projected by the City Corporation and the delegates of the Vestries and District Boards of the Metropolis; and it was doubtless with the view of assisting the Committee in formulating their ideas that his Memorandum was prepared. It then goes on to state that the water question was fully inquired into by a Royal Commission in 1867-9, and was again before Parliament in connection with the Government scheme of 1880; but while the feeling in favour of placing the water supply of London in the hands of a public authority has increased in strength since Lord Cross's scheme of that year, other circumstances have much changed. The Water Companies have added to their works and to their capital; representative bodies have been created in the counties in which lie the Metropolis, its suburbs, and the basins of the Thames and Lea; and a representative government has been for the first time given to London. But perhaps the greatest change is that which has taken place in the demand for, and the supply of water. At the time of Lord Cross's scheme, it was assumed that the existing sources of supply were sufficient in quality and quantity; and this view was justified by the report of the Royal Commission of 1869. Reports of the Government Water Examiner have, however, thrown doubts on this assumption; and a report recently made by the Engineer to the Council (Mr. A. R. Binnie, M. Inst. C.E.) has confirmed them. The Engineer shows that the total average quantity of water taken daily from all sources has increased since 1867 from 98 million to 154 million gallons (an average increase of about 56 per cent., and much more than 56 per cent. in the summer months); thus approaching rapidly to the 200 million gallons which the Commission of 1869 regarded as the highest demand that could be reasonably looked forward to. He also shows that the total population supplied has risen from 3,100,000 in 1867, to 5,500,000 in 1888—an increase of 77 per cent.; and that this increase, which has taken place in 20 years, and which is apparently proceeding more rapidly than ever, is the extreme increase which the Commission of 1869 believed to be probable, and then only at some very remote period. He further shows that the Commissioners based their inference that a maximum quantity of 110 million gallons a day might safely be withdrawn from the Thames, on the hypothesis of an extreme dry-weather flow of 350 million gallons a day, at Teddington. But, as a matter of fact, the average flow of August, 1885, was 210 million gallons, falling on some days as low as 166 million gallons, and that of August, 1887, 240 million gallons, falling as low as 154 million gallons; while the water taken out of the river by the Companies on some days amounted probably to 35 per cent. of this amount. He likewise shows that the whole available supply from the Lea is already entirely utilized, and that the amount of the supplemental supply from wells is uncertain. Nor is this all. As the population in the valleys of the Thames and Lea increase, the difficulty of maintaining the purity of the water increases also, whether the water be derived from the streams themselves or from the gravel beds in the valleys.

Under these circumstances, it is obvious that the first and most pressing question for the inhabitants of London is whether the present sources of supply can be relied on, or whether the probability of having to obtain water from fresh sources, either by means of reservoirs in the upper valleys of the Thames and its feeders, or by aqueducts from distant hills in the West of England or Wales should not be fairly faced. Until this question is settled, the writer thinks it is premature to establish a new Trust; and still more premature to come to any agreement with the Water Companies. Until Parliament knows what is the task that is to be performed, they can scarcely say who is to do it; and till the value of the present sources of supply in the hands of the Companies is known, it is impossible to say what London ought to give them for their undertakings. To offer them, as has been suggested, their present income or the present market value of their shares, when a few years may make their present sources of supply comparatively inefficient, and may call for an additional expenditure of many millions for the purpose of replacing or supplementing those sources, would be the height of improvidence. Nor would a reference to arbitration afford a satisfactory means of settling the question of price. It may therefore be assumed that the first and most important question is that of a new source of supply. In what manner should this be approached?

The writer then proceeds to refer to the inquiry held by the Corporation of London (at which the Water Companies were not represented), which resulted in notices for a Bill to constitute a Trust, representing apparently all the various County Councils, corporate bodies, and authorities interested in the supply of water, or in the sources of such supply, with powers to buy up the undertakings of the Companies, and improve and regulate the supply. Delegates of the Vestries of London have given notice of a Bill enabling the Council, or a Trust to be created under the Bill, to buy up the existing water-works, and to regulate and improve the supply. Notice of a Bill has also been given to alter, and apparently to limit, the present powers of rating; and another notice relates to a Bill for authorizing water to be charged for by meter. The Committee are making inquiry concerning fresh sources of supply; but their inquiries are only now commencing, and will probably not be concluded in time for any Bills of the present session. It is therefore scarcely possible for the Council to present its case for a final settlement in a satisfactory manner this session.

In conclusion, the writer alluded to two or three other circumstances which he thinks should be mentioned. The consumers supplied by the Water Companies number 5½ million persons. Of these 1½ millions are outside the county of London, and some of the local authorities in this outside area, moved, no doubt, by the City report, are claiming representation on the new Trust. Further, the Government did, on the discussion of the Council's Bill of last year relating to the Thames Conservancy, promise an inquiry on that subject. That inquiry must necessarily be concerned with the subject of water supply; since one of the principal functions of the Thames Conservators in relation to the upper Thames is to keep the water pure, for which they receive £16,000 a year or more from the Water Companies. The Government are also under an obligation to bring in a Bill, or take some other steps concerning the lightermen on the Thames. There are therefore in contemplation various schemes of great magnitude, intimately connected with each other, relating to the River Thames and to the water supply of London. On some of these the Government are pledged to take action; and it will almost inevitably be obliged to take some part in all of them. Indeed, it is out of the question to suppose that anything so important as the reform of the water supply of London could take place without the active intervention and help of the Government. The Government are not likely to be prepared with any definite plan; and are not likely, under existing circumstances, and after all that has passed, to pledge themselves to any of the schemes before Parliament. At the same time the writer considers that their desire is, in the main, the same as that of the Council—viz., to provide the Metropolis with an adequate supply of water, on the best terms which are compatible with justice to existing interests; and they will no doubt be entirely at one with the Council in the desire to throw light on the question of fresh sources of supply.

The Proposed Water Commission.

In our article on "Water and Sanitary Affairs" last week, we gave an indication of the scope of the Bill promoted by the Corporation of London for the establishment of a Commission to take the control of the water supply of the Metropolis. The following is an epitome of the measure:—

The object of the Bill is to "constitute a Public Authority to promote Bills in Parliament for improving the supply and diminishing the cost of water in the City of London and the County of London, and adjoining boroughs and populous places, and for other purposes;" and the preamble states that it is expedient that such a body, representing the interests and commanding the confidence of the water consumers, should be established for the purposes specified, as well as for equalizing and uniformly adjusting the existing charges for water. The first clause gives the short title of the Act—viz., "The London Water Commission Act, 1891." Clause 2 deals with the incorporation of the Commission; and clause 3 defines their powers. It is specified that the Commission are to have power to promote Bills in Parliament for all or any of the following objects:—

(1) To acquire, construct, and maintain water-works, aqueducts, wells, reservoirs, and other works, and do any necessary acts in connection therewith, so as to secure and afford an alternative or independent water supply. (2) To acquire, either by arbitration or agreement, any existing or future water-works or any water, or right to take or convey water, within the watersheds of the Rivers Thames and Lea, and any rights, powers, and privileges of any water company or of any public authority therein. (3) To provide for the dissolution and winding up of any water company whose undertaking shall be acquired by the Commission. (4) To make provisions for the raising of moneys secured on such stock, debentures, or preference or deferred shares or annuities, whether perpetual or redeemable, as may be required for the purpose of carrying into effect the provisions of any Act of Parliament promoted or obtained by the Commission. (5) To supply the inhabitants within such areas as Parliament shall from time to time authorize or direct with water by meter or otherwise for all necessary public or private purposes (including, if thought fit, a free supply to public baths, wash-houses, and hospitals); and, as trustees for such inhabitants, to carry on such undertakings as the Commission may, by authority of Parliament, acquire or construct. (6) To regulate, until the acquisition by the Commission of the undertaking of any company, the price or rate to be charged or levied for the supply of water by such company, and the dividends (on a sliding scale or otherwise) to be paid by such company, with a view to the equalization or uniform adjustment of the price or rate to be charged or levied within the area aforesaid. (7) To obtain such further powers as they may deem expedient for altering the numbers, constitution, and powers of the Commission, and for giving effect to the objects of the Act.

The Commission are also to have power for the following purposes:—

(*a*) To make regulations from time to time, and therein to prescribe the strength, character, weight, and materials of the appliances to be fitted after the passing of this Act in connection with the supply of water within the City of London and the County of London, and to enforce the stamping of such appliances. (*b*) To join from time to time with any county councils, municipal corporations, bodies of conservators, and urban and rural sanitary authorities interested in the control or management of the River Thames or of the River Lea, and the respective tributaries and watersheds thereof, in appointing out of their respective bodies joint committees for improving and preserving the sanitary condition of such rivers and their respective tributaries and watersheds. (*c*) To make any public or private inquiry into the existing supply of water within the said watersheds and the charges made for the same, and into the present and possible future sources of such supply, and to enter into negotiations with any public authority or water company or persons for the acquisition of any of their powers or undertakings or any part thereof.

The provisions contained in the nine remaining clauses may be shortly summarized as follows: The Commission is to consist of 51 members, who are to be nominated within six months from the passing of the Act. They are to be paid such reasonable sums for their attendance and expenses as the Local Government Board shall prescribe. Officers are to be appointed and paid by the Commission. Sums of money, not exceeding in the whole £5000, are to be advanced by the Corporation of London to the Commission within two months from the passing of the Act; and these are to be repaid, with interest at the rate of 3 per cent. per annum from the date of the advance, so soon as, in the opinion of one of Her Majesty's Principal Secretaries

of State, the Commission are in possession of funds which are conveniently available for the purpose. The accounts of the Commission are to be made up to the 31st of December in each year; and they are to be kept in a form to be indicated by the Local Government Board, and duly audited. An abstract of the accounts, when so audited, is to be sent to the Board, and laid by them before both Houses of Parliament. The word "undertaking" as used in the Bill, is to be understood to mean "all property, real and personal, and all interests and rights in, to, or out of such property, and all obligations and things in action as may be in the possession of, or belong to, any public authority, company, or person supplying, or having or claiming to have any right to supply, water to any of the public."

There are two Schedules to the Bill. The first defines how the Commission is to be constituted; and the second contains regulations as to its proceedings generally. The fifty-one members already mentioned are to be called "original members;" and they are to be strengthened by such additions as may from time to time be nominated. They are to include the Lord Mayor of London and the Chairman of the London County Council as *ex officio* members; and the remainder are to be nominated as follows: The Presidents of the Local Government Board and the Board of Agriculture are to send one each; the Corporation of London, five; the County Council, twenty; the County Councils of Middlesex and Surrey, four each; that of Essex, three; and those of Hertfordshire, Buckingham, Berkshire, and Oxfordshire, one each; the Corporations of West Ham, Richmond, Kingston-upon-Thames, Windsor, Reading, Abingdon, and Oxford one each. Whenever Parliament shall so direct, additional members may be nominated by the County Councils of Gloucestershire, Wiltshire, Hampshire, and Kent; as well as by the Conservators of the Thames and Lea. All nominated members of the Commission are to vacate office on July 1, 1896, and on the same day in every subsequent fifth year; but, of course, they will be eligible for re-election. The second schedule consists of three parts—the first containing the regulations as to the proceedings of the Commission and its Committees; the second, those relating to the future nomination of the members; and the third, those dealing with their disqualification. It is specified that the first meeting of the Commission shall be held on Nov. 2, 1891.

The Quality of the Water Supply in November.

Messrs. Crookes, Odling, and Tidy, in their report for last month on the composition and quality of daily samples of the water supplied to London, say: "The seasonable variation in the composition of the water supplied to the Metropolis—for the most part too slight to constitute a variation in character—has, with the coming on of winter, to be looked for and taken note of. As regards the November supply, however, the less favourable meteorological conditions prevailing during the month, including occasional periods of frost, were not found to have any significant effect on the analytical results obtained. Both absolutely, and still more in relation to the season, these results were entirely satisfactory. Thus, in the case of the Thames-derived water, the mean proportion of organic carbon was found to be 0·142 part in 100,000 parts of the water, with a maximum of 0·158 in any single sample examined, as against a mean of 0·136 part, and a maximum of 0·160 part met with in the previous month's supply. Similarly, the mean amount of oxygen consumed in the oxidation of the organic matter present in a gallon of the water was found to be 0·046 grain against 0·04 grain (not 0·4 grain, as printed) in the previous month's supply. Moreover, the degree of freedom from colour-tint continued to be good; the ratio of brown to blue tint of the water being as 13·1 : 20, as against a ratio of 10·4 : 20 recorded in October, and a ratio of 14·1 : 20 in September last."

The returns furnished to the Registrar-General by the London Water Companies as to the water supply of the Metropolis during the past month, show that the average daily supply was 171,127,721 gallons, as compared with 164,599,821 gallons in the corresponding month of 1889; being at the rate of 28·5 gallons per head of the population, as against 27·9 gallons in November last year. Of the entire bulk of water sent out, 86,704,054 gallons were drawn from the Thames, and 84,423,667 gallons from the Lea and other sources. Reporting upon the quality of the supply, Dr. E. Frankland said: "Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies and by the Tottenham Local Board of Health was: Kent, 0·7; Tottenham, 0·8; New River, 1·5; Colne Valley, 1·8; East London, 2·3; Chelsea and Grand Junction, 2·7; West Middlesex, 2·1; Southwark and Lambeth, 3·1. The water abstracted from the Thames by the Chelsea, West Middlesex, Southwark, Grand Junction, and Lambeth Companies had suffered marked deterioration since last month. It contained on the average 72·6 per cent. more organic matter; due, no doubt, chiefly to excess of decaying vegetation. It was in every case, however, efficiently filtered before delivery. Of the water obtained chiefly from the River Lea, that delivered by the New River Company, though organically less pure than in October, was of much better quality than any of the other river waters, and compared favourably with the deep-well waters. The East London Company's water was also superior to the Thames-derived waters. Both waters were efficiently filtered. The deep-well waters of the Kent and Colne Valley Companies and of the Tottenham Local Board of Health were, as usual, of excellent quality for dietetic use. These waters were clear and bright without filtration. The Colne Valley Company's supply was softened before delivery; and thus rendered suitable for washing."

Proposed Purchase of the Ystrad Water-Works.—A Committee has been appointed by the local authority to meet the Directors of the Ystrad Water Company to discuss a proposal recently made by some of the ratepayers to purchase their works. A section of the inhabitants, however, think that it would be injudicious to buy the concern; urging that "the few miles of pipes" which exist cannot properly be designated water-works—there being no reservoir for storeage purposes.

THE CONTAMINATION OF WATER BY LEAD.

In a recent number of the *Engineer*, Mr. J. Smillie referred to a report which had appeared in that publication of the paper on "Lead-Poisoning by Soft Water Supplies," contributed by Dr. Percy F. Frankland to the proceedings at the last Congress of the Sanitary Institute, to which we have already alluded in the JOURNAL. Mr. Smillie points out that, although the paper shows the results of bringing certain substances into contact with soft water for preventing its action on lead, no mention was made of the addition of carbonate of lime in a fine state of division, the results of which have, he says, been satisfactory in the Sheffield district. When a Committee of Inquiry on lead poisoning sat at Sheffield in February of the present year, Mr. Smillie sent a memorandum to them containing the results of a series of experiments on the matter. At that time there were several methods which had been brought prominently before the public by those who had studied the question, for using limestone in filter-beds in large revolving cylinders, &c.—methods whereby the soft water would be brought into contact with limestone, and thus rendered harmless. His own experiments showed how little action the Sheffield Redmires water had upon blocks or pieces of limestone. A block of limestone weighing 10½ lbs. was suspended in a small tank, where many thousands of gallons of this water passed through daily, and where the water was generally in violent motion. The block was kept there a month, at the end of which time its weight was roughly the same, and its edges were quite sharp—proving that the chemical action must have been of the feeblest. After a small quantity of the water had been in contact for several hours with pieces of limestone freed from all powder, it would still act appreciably on lead; and even when limestone was broken into pieces as small as peas, and any dust washed off them, and then agitated with this water, it would not prevent action on lead. But when limestone was crushed as fine as flour, and added in the proportion of 1½ grains per gallon of water, its action would cease. He used limestone and chalk crushed to a fine state of division, side by side; and, of course, the results were alike. In summing up, he ventured to assert that, in whatever way limestone might be used for treating the enormous quantity of water coming daily from Redmires dam—about 2½ million gallons—its lasting efficiency would depend upon sufficiency of limestone in a fine state of division; and he recommended that the powder should be used in the proportion of about 1½ grains per gallon. The Sheffield Water Committee resolved to use chalk in a minute state of division. This has been added to the water just as it comes from the lowest dam on entering the conduit, and is well mixed with the water before it arrives at the town—a distance of five miles. The effect has, it appears, been most marked. From pipes where water was drawn that formerly contained as much as 0·75 grain of lead per gallon, a few weeks ago, when some samples were tested, they only contained a little more than 0·1 grain, and from other pipes only slight traces of lead. The effect of sand on this water was tried by covering the bottom of a shallow lead dish with clean sand; then a little water was poured in, and allowed to stand over night. The next morning the water had dissolved a quantity of lead. Experiments with flints gave equally unsatisfactory results. Filters of sand, flint, and limestone have been found efficacious for a time; but Mr. Smillie asks if it is not probable that their partial failure is owing to the exhaustion of the powdered limestone which had been mixed up with them. As to the cost of powdered limestone, at the rate of 1½ grains per gallon, it will require 2 cwt. per million gallons; and assuming that 2½ million gallons be used per day, then 5 cwt. per day would be necessary, or about 91 tons per annum, which should not cost £100 a year—contrasting very favourably with expensive schemes, such as filter-beds, &c.

Sales of Shares.—Five fully-paid £10 shares in the *Westbury Gas Company* were sold a few days ago, at a sale by auction in the town, at from £11 10s. to £12.—Last Friday week at Colchester six new shares in the *Colchester Gas Company* were disposed of at £91 10s., three at £90, and two at £61. Two shares of £20 each changed hands at £62 10s.

Electric Lighting for Swansea.—Last Tuesday week, a meeting of the Electric Lighting Committee of the Swansea Corporation was held for the purpose of deciding what steps should be taken towards having the main streets in the town lighted by electricity. Several reports were presented on the subject, amongst them being one from Mr. W. H. Preece. He stated that of the tenders sent in for the lighting, that of Messrs. Crompton and Co. most fully complied with the specified conditions. The system they proposed to use for private lighting was similar to that which had given great satisfaction in Kensington. On the question of street lighting, the report said that arc lamps, when placed not too far apart, and when they burned with steadiness, invariably secured approbation. Glow lamps, unless of considerable power, rarely did so. The mere substitution of the incandescent fibre for a gas-flame of similar light-giving power was generally a great disappointment; and in Leamington it had proved a failure. For street lighting anything less than 32-candle power was objectionable; and Mr. Preece very much preferred 50-candle power lamps. After most careful consideration, 120 feet had been taken as the standard distance at which 500 watt arc lamps should be placed apart in the main thoroughfares of the City of London. In Paris they were placed 180 feet apart upon the Boulevards, and the effect was disappointing; but this was due to the great breadth of those thoroughfares, and to the presence of trees on the sides. In Swansea they should not be farther apart than 200 feet in the principal streets. It appeared to him that the contract with Messrs. Crompton should contain a schedule which would give prices for maintaining alight, during certain specified hours, arc lamps of 300, 450, 600, 750 watts respectively, and glow lamps of 16, 32, 50, and 100 candle power respectively. The Corporation, Mr. Preece added, must expect to pay more for the electric light than they had hitherto paid for gas; but they must also expect a very much better light, and one that would give satisfaction all round. The Committee decided to accept the tender of Messrs. Crompton to erect 23 arc lights of 2000-candle power, at a cost of £25 each per annum; the increased charge for which over gas would be £171 a year.

NOTES FROM SCOTLAND.

From our Edinburgh Correspondent.

EDINBURGH, *Saturday*.

The railway strike absorbs everything else here. Business in consequence of it is very much paralyzed; and travelling is so much of an uncertainty that no one attempts it except those who cannot do otherwise. Fears have been entertained by some that one result of the strike might be to throw the towns in darkness; but fortunately there is little likelihood of that taking place. When the strike began on Monday, there was about a fortnight's supply of coal in the Edinburgh works, and about a month's supply in the Leith works; and the strike is expected to be over long before the end of next week. The only other places in my district which are of consequence are Perth, Dundee, and Aberdeen; and from neither of them, except Dundee, is there any complaint as yet. Not one of them, however, can be much affected, because they are all in a position to procure coal by sea. As a matter of fact, Leith could do the same; the gas-works being quite close to the docks. It is true, however, that the Gas Commissioners get no coal by sea. All their supplies come from the inland portions of Midlothian and the adjoining counties; and before they could replenish their stores by sea, they would require to go into the market, and make new contracts—doubtless at a ruinous figure. Among the chief sources of their supply are the Niddrie pits, a few miles from the city; and Mr. John Walker, the General Manager of the North British Railway, was asked by Mr. R. Mitchell, the Engineer of the Edinburgh works, to allow the colliery engine to be employed to bring coal into the gas-works, but he refused on the ground that it would entail great risk of accident. Had the strike occurred before the recent reconstruction of the works, the situation would have been very different, as the storeage for coal was then very limited compared with what it is now. The Works Committee met yesterday, and had under consideration the question of how far the supply of gas coal would be affected by the strike. A favourable report was submitted by the Engineer as to the quantity of coal and lime in store; there being sufficient coal to last for thirteen days, so that during that period the manufacture of gas can go on uninterruptedly. It is stated that the only difficulty is with regard to the disposal of the ashes. In the event of the strike being prolonged, arrangements have been made with colliery-owners to send in coal with their own locomotives, in order that the supply may not become exhausted. In Dundee it is reported that no coal reached the gas-works during the week, and the coal-owners have intimated their inability to forward supplies. The daily consumption at the gas-works at this season is nearly 300 tons; and at this rate, it is calculated that there was nearly a fortnight's supply in store. In Perth there is a six weeks' supply of coal; but lime is scarce—several waggons with lime having been stopped at Ladybank, in Fifeshire, by the strike. It has been arranged, however, to have the lime conveyed in carts to Perth. In Arbroath there is a month's supply of coal; and in Stirling there is ample for a week.

Complaints of inferior quality of gas have begun to be heard of in Aberdeen. If one might judge by the violence of the language which is employed, they must be very badly off indeed there. But what is to be said of all these splutterings in public, when no complaints are lodged with the Gas Committee? The Committee met on Wednesday; and the fact that complaints were being made was mentioned, when it was stated by the Superintendent that no complaints had been received at the Gas Office. The quality of the gas was reported to have been, on Dec. 4, 22·10 candles; and on Dec. 18, 23·20 candles. On the same days last year, it was 29·79 and 28·30 candles respectively; so that, admittedly, there is a very great decrease in the illuminating power. It is the same all over Scotland. Cannel coal having become scarce, ordinary coals are being employed, which do not yield the same light; and the people who have been all along accustomed to a high standard of light, do not take kindly to the reduction in quality. On all hands, the cry is raised that if gas were given of the former quality, an increased price would not be grudged for it. But it is almost out of the question for gas-supplying bodies to take such a view into consideration. Cannel coal has about doubled in price; and if it were to be employed to a large extent, the rise in the price of gas would have to be so great that it would, without doubt, be the cause of much grumbling on the part of consumers. About 1s. 6d. per 1000 cubic feet would require to be added; and that is an increase which few would care to face. If there were any prospect of the price of cannel coming down, the present outcries might be treated as of little moment; but, unfortunately, according to present advices, matters in this respect are likely to be worse in the coming year rather than better. There are ugly rumours of a more complete organization among the owners of cannel, which will have the effect of raising, instead of lowering, the price. For some time, therefore, at least, gas engineers seem shut up to the uncomfortable conclusion that the recent rise in the price of gas cannot be a temporary expedient to tide them over an adverse period, but a step of a somewhat permanent nature. It should therefore be a question with them whether they ought not to endeavour to educate consumers to appreciate a gas of lower quality than they have hitherto been supplied with. One of the first factors in such an education would undoubtedly be a substantial reduction in price; and in this connection it is unfortunate that, along with the recent general reduction in quality, there should also have been a universal increase in price. Gas financiers will require to be as wide awake as possible in shaping their policy for next year, so as to please their customers as well as to make their undertakings commercially successful. Past experience does not show this to be insurmountable; and there need be no fear that, as before, when the time of trial comes, the man to cope with it will also arise.

From our Glasgow Correspondent.

GLASGOW, *Saturday*.

On Tuesday of this week the Paisley Corporation Gas Commissioners, in the presence of a large number of influential gentlemen belonging to the town, to Glasgow, and other places, "inaugurated" their new gasholder in a befitting manner. This addition to the gas storeage capacity at Paisley has been much spoken of during the past year, owing to the fact that it was by many persons believed to be the largest holder in Scotland—its available capacity being about 1,400,000 cubic feet. But since the addition of third lifts to two of the large holders at the Dawsholm works of the Glasgow Corporation Gas Commissioners, the claim of the new holder at Paisley to be the largest north of the Tweed, has not been encouraged by those persons who knew the actual facts of the case. The proceedings at the side of the holder began with the taking of a "group" photograph of the Provost, Magistrates, and Town Councillors, and the invited guests; and then Mr. James Donald, as representing the contractors—Messrs. James Goldie and Sons, of Glasgow, for the tank, and Messrs. Hanna, Donald, and Wilson, of Paisley, for the holder—presented to Provost Johnstone a very handsome Maltese cross, bearing suitable inscriptions, a representation of the holder, the arms of the burgh, and a bas-relief of the Chief Magistrate himself. This cross, serving as a key, Provost Johnstone used to turn on the gas from the holder in the town gas-mains—an operation which elicited loud applause from the assemblage. After thanking the donors of the cross, he proceeded to deliver an address, in the course of which he mentioned many interesting details connected with the gas-supply undertaking of the town. Subsequently the gentlemen composing the party were conveyed in carriages to the George A. Clarke Town Hall, where the afternoon ceremony was completed by a banquet, at which the Provost presided, and ex-Bailie M'Farlane, Convener of the Gas Committee, discharged the duties of the vice-chair. For the present, a fuller notice of the "inaugural" speech, together with a detailed description of the present and past of the Paisley gas-supply undertaking, must be held in reserve, notwithstanding the great amount of interest attaching to the matter, and to the improvements Mr. Geo. R. Hislop, the much-respected Gas Manager, has carried out in the 25 years he has held that post.

This event at Paisley on Tuesday has been quite overshadowed during the week by a gigantic strike of the engine drivers, stokers, pointsmen, and other servants of the three Railway Companies by whom the carrying of passengers, goods, minerals, &c., in Scotland is almost wholly monopolized. This great labour disturbance began on Monday morning by about 3000 hands ceasing to work, chiefly on account of the alleged unwillingness of the Companies' Directors to accede to the proposal of the men to make ten hours the length of the regular working day. Since Monday the strike has gone on spreading amongst the railway servants until now, when there are, it is said, about 9000 hands out. As might be supposed, the carrying trade of the country has been completely paralyzed; the result being an amount of personal and business inconvenience which has probably never previously been experienced in Scotland. Many large industrial establishments have had such a deficient supply of coals during the week that they have had to "call a halt," with the result that their gates have been closed for the New Year's Day holidays some days before the usual time. It is at the gas-works, however, that the greatest amount of anxiety has been felt. All up and down, gas commissioners, gas directors, and gas managers have been put on tenterhooks for fear that their supplies of coals should run down before the strike has completed its course by a victory on one side or the other, or by an amicable settlement of the dispute. At the Glasgow Gas-Works, where the present needs amount to about, if not upwards of, 2000 tons per day, the anxiety has been exceedingly keen over most of the week—Mr. Foulis, on whom more especially the brunt of the responsibility devolves, having had no rest either day or night. A day or two since, it was stated by a member of the Corporation Gas Committee that the stock of coal in hand at the three gas-works was equal to the demand for about nine to twelve days. Whether or not this was actually the case, no effort has been spared by the executive officers of the Gas Trust to keep up the supply of coals by "hook or by crook." Most urgent demands have been made upon coal-masters having contracts with the Trust to send forward every truck of coal that might be available, even though they had to use their own locomotive engines. It is said that various coal firms whose pits are near the banks of the Forth and Clyde Canal are being pressed into service to deliver all the coal within their power to the works at Dawsholm, which are close by that waterway at Maryhill. There is every probability that these works will be finally supplied by the canal lighters, even though all the mineral locomotives should be kept within the engine-sheds. Other gas-works throughout the West and South of Scotland have been, and still are, in similar straits for want of coal; and lest the gas supply should actually cease, consumers have in many places been urged to have candles and oil-lamps ready for lighting. From Dumfries I learn to-day that the supply of coal from Muirkirk and Hamilton to the gas-works of that town has been entirely stopped. As the supply that is kept in stock is usually little more than what serves for a week's make of gas, a prolongation of the strike must entail serious consequences. Yesterday morning, however, four trucks of coal were received from Cumnock; and it is thought not unlikely that it may yet be necessary to cart coals from Sanquhar to Dumfries; or it may be desirable to open connection with the Cumberland coal ports by steamers. In a sense, Dumfries affords an example of the condition of things that is prevailing in many other towns in respect of the gas supply.

The strike has led to an extraordinary advance in the price of coal suitable for household purposes; and the Glasgow Gas Commissioners, under the circumstances, have intimated to the public that at present they can be supplied with coke at their works at the price of 6s. 6d. per ton for riddled coke, and of 5s. for unriddled.

Out of 39 applicants for the vacancy, Mr. James Ballantyne, lately assistant to his brother the gas manager in Rothesay, has been appointed to take charge of the gas-works at Stevenston in Ayrshire. He is certainly one of the youngest gas managers in Scotland.

On Tuesday of this week the Glasgow East-End Industrial and Fine Art Exhibition was formally opened by the Marquis of Lothian, Secretary for Scotland. In recent years, both at home and abroad, almost all such exhibitions have depended on electricity as the lighting agent. It is very different, however, with the Glasgow Exhibition, which has one of the finest displays of gas lighting ever seen.

Business in the iron trade has been almost at a standstill this week, chiefly owing to the holidays. Prices have been just a little firmer.

The coal trade is much disorganized; and it is difficult to say what the prices really are.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Dec.* 27.

Sulphate of Ammonia.—A moderate business has been done during the week; but generally the market had a holiday aspect. A few transactions are reported at £10 12s. 6d. to £10 13s. 9d. f.o.b. Hull; and £11 11s. 3d. to £11 12s. 6d. f.o.b. Leith; but, at the latter port, deliveries are being retarded through the strikes on the Scottish railways. The nitrate market has been steady, at about 7s. 7½d. per cwt.

LONDON, *Dec.* 27.

Tar Products.—Owing to the holidays, there has been little or no business done in this market. Prices, however, keep fairly firm; and makers, being well sold, are indifferent to the fluctuations which characterize business at this period of the year. The better tone in carbolic noted last week is more than maintained; and it is expected that this article will see better prices with the turn of the year. There is practically no change in the market quotations; and these are as follows: Tar, 30s. Pitch, 35s. Benzol, 90 per cent., 4s. 7d.; 50 per cent., 3s. 6d. Toluol, 2s. Solvent naphtha, 1s. 9d. Crude naphtha, 1s. 8d. Creosote, 2¼d. Heavy oil, 3d. Crude carbolic, 60's, 1s. 6d. Cresol, 9d. Anthracene (30 per cent.), "A" quality, 1s. 4d.; "B" quality, 1s. 1d.

Sulphate of Ammonia.—The spurt in this market which commenced some ten days ago, has entirely disappeared; and the article is to-day as flat as it can be—small sales only being reported during the week, at prices ranging from £10 7s. 6d. to £10 12s. 6d., according to position and delivery. Ammoniacal liquor is weak, at 5s. 9d. to 7s., according to position and strength.

A Serious Interruption in the Supply of Water at Ripon.—By the bursting of a main-pipe (chiefly owing to the frost which prevailed), the city of Ripon was without a supply of water for two or three days last week, and of course much inconvenience was thereby occasioned. Immediately the accident occurred, the Water-Works Manager (Mr. F. Shepherd) took steps to have the engines at the old pumping station put into working order with a view of obtaining a supply for the city from the River Ure.

A Stoppage in the Gas Supply at Ipswich.—What is termed a "mysterious incident" occurred at Ipswich early on Christmas morning; and it is said to have "excited a good deal of public interest and concern." At about 5.15 the supply of gas in the centre of the town failed; and at 5.40 it was resumed as suddenly as it had stopped. No great escape of gas is reported; and the sorters at the Post Office appear to be the only persons who suffered from the cessation of the supply, as they were delayed in their work for about twenty minutes.

Extension of the East Worcestershire Water-Works.—On the 13th inst., a company assembled at the Burcot pumping-station of the East Worcestershire Water Company, to witness the starting of a new engine for pumping the supply of water for the Lickey district. The engine, which was supplied by Messrs. Beck and Co., of London, has a pumping capacity of 6000 gallons per hour. After a short description of the machinery, particulars of the quantity of water supplied, &c., had been given by the Resident Engineer and Manager (Mr. W. T. Layton), Lord Windsor, the Chairman of the Company, started the engine, which worked very satisfactorily. In a brief address, his Lordship remarked that this was the first extension the Company had been called upon to make; and he was proud to have had the honour to start the engine.

Sewerage Scheme for Melbourne.—Mr. J. Mansergh, M. Inst. C.E., who visited Melbourne about a year since, at the request of the Victorian Government, to report upon the sewerage of the Victorian metropolis, has furnished the result of his investigations. He recommends that Melbourne should be divided into two systems—eastern and western. All the district to the east is to drain into a pumping-station at the South Yarra Railway Bridge, from which the sewage is to be forced to the high ground at Malvern. It will then be discharged by gravitation to a sewage farm at Mordialloc. The drainage of the district to the west of the dividing-line will flow to a pumping-station at Yarraville, will be pumped thence to Newport, and will then flow by gravitation to a second sewage farm at Wyndham. The city drainage will be taken to this farm by means of a deep sewer, which crosses underneath the Yarra at Port Melbourne. The estimated cost of the works, including the sewage farms, is £5,500,000; and it is computed that they can be completed by 1898, if vigorously prosecuted. It is estimated that it will cost upwards of £1,000,000 additional to make the necessary connections, &c., between the houses and sewers in the Metropolitan area; but this expense will fall on the owners.

Extraordinary Consumption of Gas in Birmingham.—During the week ending the 13th inst., the demands upon the Birmingham Corporation Gas-Works were unusually heavy. On Tuesday, the 9th inst., the total output reached 23,612,000 cubic feet—the highest yet recorded. The largest previous daily output was 23,536,000 feet, on Jan. 13, 1888. The following was the daily output of gas for the week: Sunday, 10,271,000 feet; Monday, 20,082,000 feet; Tuesday, 23,612,000 feet; Wednesday, 21,892,000 feet; Thursday, 22,070,000 feet; Friday, 21,403,000 feet; and Saturday, 18,799,000 feet—making a total of 138,129,000 feet. A comparison of the weekly totals of this and past years shows that this week's consumption was also the heaviest that the gas-works now under the control of the Corporation have had to deal with since their establishment. The Gas Committee's returns are made up to Thursday; and the following is a comparison of the output for the seven days ending last Thursday week with the corresponding week last year, and with the highest previous weekly total—viz., that for the seven days ended Thursday, Dec. 19, 1889: Week ended Dec. 11, 1890, 136,710,000 cubic feet; week ended Dec. 12, 1889, 125,789,000 feet; and week ended Dec. 19, 1889, 127,412,000 feet. The discrepancy between the seven days' output as calculated up to Thursday last, and that given above as the total for the week ended Saturday, the 13th inst., is accounted for by the rapid rise in the demand for gas which always takes place as Christmas is approached.

Increase in the Price of Gas at Hailsham.—The Hailsham Gas Company have given notice to their consumers of their intention to increase the price of gas from 5s. to 5s. 5d.

The Gas Stokers' Agitation at Stockport.—The Stockport Corporation Gas Committee have resolved to pay the gas stokers in their employ time-and-a-half for Sunday labour. This means an advance of 2s. 6d., or the weekly earnings advanced from 38s. to 40s. 6d. The hours will remain as hitherto. Whether the men have accepted the decision of the Committee has not yet transpired.

The Maidstone Town Council and Electric Lighting.—The Maidstone Town Council recently resolved to apply next session for a Provisional Order to invest them with electric lighting powers, and to oppose the application of the Electric Lighting Installation and Maintenance Company for similar powers. This step has led the Company to give notice that they will not proceed in the matter in the present session.

The Leakage at the Eccup Reservoir of the Leeds Corporation.—At a meeting of the Water Committee of the Leeds Corporation on the 12th inst, the Borough Engineer (Mr. T. Hewson) reported that the leakage at the Eccup reservoir had been entirely stopped by the operations in the trench he is sinking. He further stated that he had commenced to run the water out of the reservoir, so as to reduce as far as possible the influx of water into the trench, which at the present time amounted to more than a million gallons per day.

Electric Lighting at Abercanaid.—Last Tuesday evening, the colliery village of Abercanaid, near Merthyr Tydvil, was lighted by electricity; Mr. T. H. Baily, General Manager of the Plymouth Collieries, having arranged with the Local Board of Health to carry out the installation. The switches were turned on by Mr. H. W. Lewis, a member of the Board, in the absence of the Chairman. The village had previously been lighted by 14 gas-lamps, which cost £4 10s. each per annum. The new arrangement with the Plymouth Colliery proprietors involves an expense of £80 per annum for 25 incandescent lights, each of 32-candle power.

Sale of Stock in the Derby Gas Company.—The Derby Gas Company offered for sale by auction, last Thursday week, £20,000 of new stock. It was put up in lots of £100 nominal value; the premiums realized thereon ranging from £16 10s. down to £5 per cent.—the total amount being £1539. A few days previously at a sale of miscellaneous shares, the following prices were realized for stock in the same Company: £450 worth of 10 per cent. stock sold at the rate of £217 per cent. for the first £300, and the remainder at £218 10s.; £797 of 7 per cent. stock, at £151 per cent. for the first £500, and the balance at £150 10s.; and £150 of 4 per cent. mortgage stock, at £112 per cent.

Gravesend and the Electric Light.—The Gravesend Town Council have resolved not to move farther with their application for electric lighting powers. At the last meeting the Mayor (Mr. G. M. Arnold) reported the result of a public meeting held on the subject, at which there "were about 100 people (!)" who "were practically unanimous" in favour of the electric light. A motion was proposed by Mr. Layborn, to the effect that the Council proceed with their application. In the course of the discussion which thereupon ensued, Alderman Edmonds pointed out that at several places at which the electric light had been installed, it had been discontinued owing to the expense; and he counselled the members to wait until the light was more fully developed. The Alderman was strongly supported by other prominent members; and, in the end, the motion was defeated.

Electric v. Gas Lighting at Barnet.—At the last meeting of the Barnet Local Board, Mr. Parsloe called attention to the item of £487 put down in the accounts as the cost of the public lighting, and asked if it represented the lighting of the town by electricity for one year and the few lamps still burning gas. The Clerk said it included everything for the public lighting from March, 1889, to March, 1890; and that the contract for the electric lighting came to as near £400 as possible. The Chairman (Mr. Stevens) said that it was less than £400, even including extra electric lamps. Mr. Samuels remarked that the account for the present quarter was £96 6s.; and it had never been so high before. There had been five extra lamps started. He thought Mr. Parsloe had done well to raise a question as to the £87, which was no doubt correct; but he could not at the moment recall how it was made up. Mr. Parsloe said if, as had been stated, the electric light cost £390 per annum, the Board would be spending £97 odd a year for the gas burnt in the remaining lamps. The Chairman remarked that he felt there must be something wrong; but he could not see how it was. The question was referred to the Lighting Committee, for them to bring up a report thereon. The electric lighting contractors have replied to the correspondent in the local paper who said that the rates would be increased by 4½d. in the pound, owing to the adoption of the electric light. They gave the following calculations to show the comparisons of the two systems: "Gas in the year 1887-8, lighted until 11.30 to 12, £353 12s.; add 20 per cent. for additional time of lighting to compare with electric light, £70 14s. 4d.—total, £424 6s. 4d. Electric light average per annum, lighted until 12.30 midnight, £377 17s.; deduct five lamps added to light thoroughfares not lighted by gas, £27—total, £350 17s. Difference in favour of electric lighting per annum, £73 9s. 4d. The Gas Company's price was £2 18s. per annum for a 14-candle power burner, as against our price of £2 14s. per annum for a 16-candle power electric light, and £5 8s. per annum for a 32-candle power electric light." The correspondent above referred to has sent another letter giving, as, he asserts, the exact figures as to the cost of lighting the town. He states that with gas for the year ending March, 1888, it was £339; the electric light for the year ending March, 1890, costing £487. This additional expenditure of £157 represents, he says, an addition to the rates of 1·8d. in the pound. He adds: "Since I wrote before, I have seen a statement in print to the effect that the Barnet Local Board contemplates undertaking to light the town by electricity without the intervention of a contractor. In that case, the cost to the ratepayers would be at least 6½d. in the pound, instead of 4½d. as at present. But it is impossible to treat such a statement as anything but a hoax." Another correspondent points to the recent decision at Lewes in favour of gas, and strongly advises a return to this illuminant at Barnet.

Leeds Corporation Improvement Bill.—The Leeds County Council have held special sittings to discuss the provisions of the Bill for general purposes which they proposed to promote in the present session of Parliament. The several sections of the Bill were fully considered, and many important modifications were made; but, on the vote being taken, the measure was rejected. Some of the clauses related to the Corporation gas undertaking. Among other things, it was intended to consolidate the old Gas Acts; to embody the clause of the Gas-Works Clauses Act of 1871 prescribing the standard illuminating power of the gas at 16 candles; and to make provision for 24 hours' notice being given to the Corporation before gas pipes or fittings in new houses were plastered over.

Advance of Wages to Newry Gas Workers.—The Gas Committee of the Newry Town Commissioners recently received an application from their gas-works employees for an increase of from 3s. 6d. to in some cases 6s. per week in wages. A Committee meeting was held last Saturday week to consider the question, when the matter was deferred until the meeting of the full Board of the Town Commissioners on Monday, when the subject was again discussed. The men receive from 18s. to 20s. per week; and the Committee last Saturday week offered what they thought was fair and reasonable. Their terms, however, were refused. In their first application, the men gave notice that they would cease work at the end of the week provided their demands were not conceded. A Committee of the Commissioners was appointed at Monday's meeting to have an interview with the men in reference to the matter; and, after a conference, they made advances averaging from 3s. to 7s. each man per week, and this was accepted.

The Purchase of the Public Lighting Plant by the Dublin Corporation.—At a special meeting of the Dublin Municipal Council yesterday fortnight, a resolution was submitted adopting the report of the Special Gas Committee on the question of the purchase of the public lighting plant (*ante*, p. 1145). To this Mr. Shanks moved, as an amendment—"That the report be approved as to the purchase of the lighting plant, and that a loan of £14,341 be applied for to pay for same, that the further consideration of the report be postponed until the second meeting in January, 1891, and that in the meantime the Special Gas Committee prepare and submit to the Council full information regarding the cost of the Public Lighting Department from 1886 to 1890 in the form of a comparative table." Alderman Pile having seconded the amendment, Mr. Mayne urged that the question should be discussed then. When the Committee was appointed, the cost of public lighting was, he said, £10,341; and it was now reduced to £8425. After some discussion, the amendment was adopted.

Frost and Gas-Mains.—By the breaking of a gas-main under the footpath in consequence of frost, the lives of four families residing in Birch Road, Attercliffe, were placed in imminent danger early last Tuesday morning. The gas, it appears, penetrated into the cellars, and rose to the bedrooms. Fortunately, however, two or three of the inmates detected the smell of gas; and these at once set to work to try and arouse their neighbours, some of whom were found to be in a very critical condition. Medical aid was obtained; and most of the persons suffering from the effects of the gas rapidly recovered—only one woman remaining unconscious for any length of time.——By the forcing of the joints of a gas-pipe by frost, an explosion occurred at the Alhambra Variety Theatre, West Hartlepool, last Tuesday evening. A strong smell of gas was observed in the pay-office by the attendants when opening the building. One of the persons present struck a match, and a fearful explosion resulted, shattering the office, and severely burning two money-takers about the head and face. A programme boy was so seriously injured that he had to be conveyed to the hospital.

Northern Coal Trade.—The coal trade of the North has been affected by the holidays; but steam coal has been steady, at about 11s. 9d. per ton for best Northumbrian qualities, free on board, and at about 5s. for small steam. The demand is fairly good, and the pits have had tolerably full work. Gas coal has varied more. The foggy weather largely increased the consumption, just at the time when that is at its highest point; and some collieries were able to obtain advanced prices for additional supplies. Generally, the price ranges from 10s. 6d. to 11s. per ton, though higher figures are asked by some collieries. The demand has been very large—probably more than in any preceding corresponding periods. Manufacturing coal is generally easier—the holidays being longer; and this lessens the demand. Household fuel is dull, for this season of the year. In coke a good business is being transacted; and the price is steadily maintained for best kinds—the blast-furnace qualities ranging from £1 to £1 2s. per ton, free on board. Gas coke is steady; but the output is heavy just now. One sale is noted at about 12s. per ton, for one of the cement-works on the Tyne, from a gas-works down the river.

Lighting of the Hofburg at Vienna by Electricity.—Writing from Vienna on the 19th inst., the correspondent of the *Standard* said: "For the last day or two the time-honoured Hofburg has been, after dusk, one great illumination; the windows looking over the Burgplatz and the Franzensplatz, or the inner square of the Hofburg, being a blaze of light. The explanation is that experiments have been made with the electric light, which is to be installed throughout the palace. For the present only 52 halls, reception-rooms, and apartments have received the new illuminant; but next spring it will be extended to the remaining 41 rooms, which are now occupied. The incandescent system is the only one adopted; and the chief difficulty experienced in fixing it arose from the strict orders against any alteration of the character and outward appearance of the handsome candelabra, in embossed gold and crystal, which date from the time of the Emperor Francis I. In the great Ceremoniensaal alone, there are 27 of these, with 54 lights apiece. The difficulty was surmounted by inserting small white lacquered wooden tubes, resembling candles at a distance, into the old lustres; each tube being fitted with a moveable lamp. The entire installation, when completed, will consist of 5250 incandescent lamps, equal to 30,000 wax candles, in the apartments, and nearly 1800 lights in the entrance halls, galleries, and staircases, or some 7000 lamps in all. This will be the largest installation in any one building in Europe; the length of the wires inside the building being 15 English miles."

Lancashire Coal Trade.—The demand for most descriptions of coal continues brisk; and in some cases collieries are unable to deal with the orders received. Best house-fire coal sells at the pit's mouth at 12s. 6d. to 12s. 9d. per ton; second qualities, from 11s. to 11s. 6d.; and the commoner sorts, about 9s. to 9s. 6d. Burgy is quoted at 7s. 6d. to 8s. per ton; and best slack, from 6s. 6d. to 7s. 3d., with 5s. 6d. for lower qualities. Steam coal for shipment remains without change; and as regards coke the same remark applies.

Gas-Engines for Driving Printing Machines.—In their issue of the 18th inst., the *Liverpool Echo* described some recent extensions of their premises and plant; one of the main additions being the erection of another "Victory" machine—making five in all, and rendering their available machine power almost double that of any of the other Liverpool newspapers. The five Victory machines in use are worked daily—four of them being driven by steam, and the latest one by a 12 horse-power "Fawcett" gas-engine, invented by Mr. Charles G. Beechey. Up to the present (says our contemporary) it has rather been a difficulty with gas-engines that they would not drive one of these machines with sufficient steadiness to produce good printing. Mr. Beechey, however, has overcome this difficulty; for the engine employed drives the printing machine quite steadily. This can be easily understood, as the engine has an impulse at every revolution; and the force of each impulse, and the quantity of gas consumed, are proportioned to the load. Another remarkable feature of this engine is the extreme simplicity of its working parts. It has no cams, side shaft, clack valves, geared wheels, or slide valve; the whole of the operations necessary in a gas-engine being performed by a small equilibrium piston valve, recently patented, which is actuated by an eccentric on the crank shaft of the engine in the same way as a horizontal steam-engine. The engine works very quietly, and is easy to start. We understand, however, that a patent "automatic" self-starter can be applied when required, to obviate the necessity of starting the engine by turning the fly-wheel by hand. This engine is capable of developing upwards of 30 indicated horse power, with a consumption of gas of only between 16 and 17 cubic feet per horse power per hour. The arrangements for the gas supply and fittings were carried out by the Liverpool Gas Fittings Company, under Mr. John Haynes, their Superintendent.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see *ante*, p. 1331.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
390,000	10	10 Oct.	10½	Alliance & Dublin 10 p. c.	10	16–17	..	6 3 6
100,000	10	,,	7½	Do. 7 p. c.	10	12–13	..	5 15 6
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	107–109	..	4 11 9
100,000	20	27 Nov.	8	Bahia, Limited	20	17–19	..	3 8 5
200,000	5	13 Nov.	7½	Bombay, Limited	5	6¾–7¼	..	5 3 5
40,000	5	,,	7½	Do. New	4	5–5⅛	..	5 9 1
380,000	Stck.	14 Aug.	12½	Brentford Consolidated	100	212–217	..	5 12 11
125,000	,,	,,	9½	Do. New	100	155–160	..	5 15 7
220,000	20	11 Sept.	11½	Brighton & Hove Original	20	40–42	..	5 9 6
320,000	20	28 Mar.	11½	British	20	43–45	..	5 0 0
50,000	10	11 Sept.	11	Bromley, Ordinary 10 p. c.	10	18–20	..	5 10 0
39,000	10	,,	8	Do. 7 p. c.	10	13–14	..	5 14 3
328,750	10	13 Nov.	6	Buenos Ayres (New) Limited	10	11–12	..	5 0 0
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	103–106	..	5 13 2
150,000	20	14 Aug.	8	Cagliari, Limited	20	26–28	..	5 14 3
550,000	Stck.	10 Oct.	13½	Commercial, Old Stock	100	250–254	..	5 8 3
130,000	,,	,,	10½	Do. New do.	100	198–203	..	5 5 11
130,000	,,	27 June	4½	Do. 4½ p. c. Deb. do.	100	119–124	..	3 12 7
557,320	20	13 June	13	Continental Union, Limited	20	49–51	..	5 1 11
242,680	20	,,	13	Do. New '69 & '72	14	33½–34½	..	5 5 3
200,000	20	,,	10	Do. 7 p. c. Perf.	20	39–41	..	5 17 7
75,000	Stck.	25 Sept.	10	Crystal Palace District	100	195–205	..	5 17 7
234,060	10	16 July	—	European, Limited	10	19–20	..	—
120,000	10	,,	—	Do. New	10	19–20	..	—
354,060	10	,,	—	Do. do.	7½	13½–14½	..	—
5,470,620	Stck.	14 Aug.	13	Gaslight & Coke, A, Ordinary	100	236–241	+1	5 7 10
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	98–101	..	3 19 3
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	249–254	+2	3 18 9
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	119–123	..	4 1 3
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	177–182	..	4 2 5
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	164–168	..	4 3 4
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	247–252	+1	3 19 4
176,000	,,	—	—	Do. K, 6 p. c. Prf.	100	147–152	..	3 19 0
1,061,150	,,	12 Dec.	4	Do. 4 p. c. Deb. Stk.	100	111–116	..	3 9 0
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	121–126	..	3 11 5
650,000	,,	,,	6	Do. 6 p. c. do.	100	158–162	..	3 14 1
3,800,000	Stck.	13 Nov.	12	Imperial Continental	100	220–225	..	5 6 8
75,000	5	12 Dec.	5	Malta & Mediterranean, Ltd.	5	5–5¼	..	5 9 1
560,000	100	1 Oct.	5	Met. of Melbourne, 5 p. c. Deb.	100	109–111	..	4 10 1
541,920	20	27 Nov.	6¼	Monte Video, Limited	20	18¾–19¾	..	6 13 4
156,000	5	27 Nov	10	Oriental, Limited	5	8⅞–9⅛	..	5 8 1
60,000	5	25 Sept.	7	Ottoman, Limited	5	5–5⅛	..	6 7 3
166,870	10	16 July	4	Pará Limited	10	3–4	..	10 0 0
				People's Gas of Chicago—				
420,000	100	3 Nov.	6	1st Mtg. Bds.	100	95–100	..	6 0 0
500,000	100	1 Dec.	16	2nd Do.	100	93–98	..	6 2 5
130,000	10	10 Oct.	10	San Paulo, Limited	10	13–17	−½	5 17 8
500,000	Stck.	28 Aug.	13½	South Metropolitan, A Stock	100	280–285	..	4 12 11
1,350,000	,,	,,	11½	Do. B do.	100	228–233	..	4 18 9
141,500	,,	,,	2	Do. C do.	100	235–245	..	4 17 11
650,000	,,	27 June	5	Do. 5 p. c. Deb. Stk.	100	142–147	..	3 8 0
60,000	5	11 Sept.	11½	Tottenham & Edm'nton, Orig.	5	11–13	..	4 8 5
				WATER COMPANIES.				
729,221	Stck.	13 June	10†	Chelsea, Ordinary	100	274–279	..	3 11 8
1,720,560	Stck.	10 Oct.	7½	East London, Ordinary	100	213–218	..	3 8 10
544,440	,,	27 June	4½	Do. 4½ p. c. Deb. Stk.	100	142–147	..	3 1 2
700,000	50	12 Dec.	9	Grand Junction	50	117–122	..	3 13 9
708,000	Stck.	14 Aug.	10½	Kent	100	273–278	..	3 15 6
1,043,800	100	27 June	9½	Lambeth, 10 p. c. max.	100	243–254	..	3 14 9
406,200	100	,,	7½	Do. 7½ p. c. max.	100	198–203	..	3 13 10
260,000	Stck.	25 Sept.	4	Do. 4 p. c. Deb. Stk.	100	120–123	..	3 4 6
500,000	100	14 Aug.	12½	New River, New Shares	100	360–365	..	3 6 5
1,000,000	Stck.	31 July	4	Do. 4 p. c. Deb. Stk	100	125–128	..	3 2 6
902,300	Stck.	12 Dec.	7	S'thwk & V'xhall, 10 p. c. max.	100	175–180	..	3 17 9
126,500	100	,,	7	Do. 7½ p. c. do.	100	167–172	..	4 1 4
1,155,066	Stck	12 Dec.	10	West Middlesex	100	260–265	..	3 15 6

† Next dividend will be at this rate

GWYNNE & BEALE'S PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams: "GWYNNEGRAM LONDON." TELEPHONE No. 2698.

GWYNNE & CO.,

HYDRAULIC AND GAS ENGINEERS,

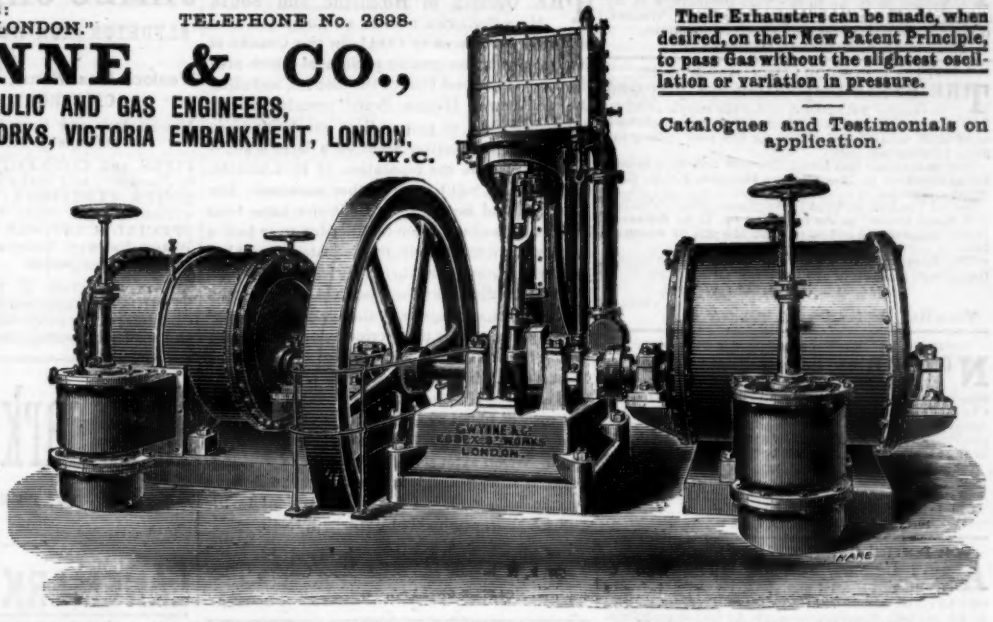
ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C.

Thirty-three Medals at all the Great International Exhibitions have been awarded to GWYNNE & Co. for Gas Exhausters, &c.

They have completed Exhausters to the extent of 22,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, STEAM-PUMPS for Tar, Liquor, or Water; CENTRIFUGAL PUMPS and PUMPING ENGINES, specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH-SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.



Their Exhausters can be made, when desired, on their New Patent Principle, to pass Gas without the slightest oscillation or variation in pressure.

Catalogues and Testimonials on application.

Exhausting Machinery at Fulham and Bromley Gas-Works—each set passing 400,000 cub. ft. per hour, drawing 14 miles distant from Beckton.

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAYS.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.

Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

CANNEL COAL, ETC.

JOHN ROMANS & SON, EDINBURGH. Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.

Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH; NEWTON GRANGE, NEAR DALKEITH, } SCOTLAND.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 85, Gracechurch Street, LONDON; 70, Wellington Street, GLASGOW; 10, Marsden Street, MANCHESTER; and 96, Reade Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.

Head Office: MIDDLESBROUGH. Correspondence invited.

EXTRACT from the Harrogate Gas Company's Report, dated the 5th of February, 1890: Coal consumed, 8600 tons. Gas made, 92,880,000 feet; ditto sold, 84,880,000 feet; ditto unaccounted for, 8,000,000 feet; quantity made per ton, 10,800 feet; ditto sold, 9869 feet. Illuminating Power, 16·1 candles. Coals used, Brancepeth. Owners, Strakers and Love, Newcastle-on-Tyne; who have also Brandon Hutton Seam Unscreened Gas Coal. Analysis, 10,509 cubic feet per ton; Illuminating Power, 16·2 candles.

COZE'S Automatic Apparatus for CHARGING AND DISCHARGING GAS-RETORTS. For Illustrated Advertisement of this System, see p. 1128.

Inquiries should be addressed to THE AUTOMATIC COAL-GAS COMPANY, LIMITED, 86-88A, LEADENHALL STREET, E.C.

TAR and Liquor wanted. BROTHERTON AND CO., Commercial Buildings, LEEDS.

DRAUGHTSMAN, having been engaged upon Plans and in Superintending the carrying out of Work in connection with enlargements and extensions at a Corporation Gas-Works, is desirous of similar EMPLOYMENT. Good Draughtsman, experienced, and practical. First-class testimonials.

Address No. 1893, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Situation as Under MANAGER in Gas-Works. Four years' experience, and at present employed with one of the Leading Firms of Gas Engineers.

Apply, by letter, to No. 1886, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Traveller to sell Wet and Dry Meters in any part of the Kingdom.

Apply, by letter, to No. 1888, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

JAMES LAWRIE & CO. supply Best SCOTCH CANNEL COALS, Best FIRE-CLAY RETORTS, BRICKS, TILES, and LUMPS; BOILER SEATING BLOCKS, FLUE COVERS, and SILICA BRICKS for SPECIAL FURNACE WORK; COKE BARROWS, BOGIES, and SMALL WAGONS.

Postal Address: 1, WHITTINGTON AVENUE, E.C.
Telegram Address: "EIRWAL LONDON."

W. C. HOLMES & Co., Huddersfield, AND 80, CANNON STREET, LONDON, Contractors for Gas-Works complete, Makers of Gas-holders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.

*** See Advertisement p. 1362 of this week's issue.

Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.

First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.

Telegraphic Address: "Braddock, Oldham."

WANTED, by the Gravesend and Milton Gas Company, a thoroughly practical GAS-FITTER. One accustomed to Main and Service laying preferred. Wages, 28s. per week of 56 hours.

Apply, in writing, enclosing references, to Mr. JOSEPH DAVIS, Engineer, Gas-Works, Gravesend, KENT.

Dec. 22, 1890.

WANTED, for a Country Gas-Works, making about 55 Millions per annum, a good steady practical FOREMAN. Must be a good neat Fitter; have a thorough knowledge of Engines, Exhausters, Pumps, and the erection and working of a Gas Plant generally; a good Carbonizer; and able to take Meter Indices, &c.

Applications, in own handwriting, stating age, also if married, and wages required, with references, &c., to be addressed to No. 1894, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, to purchase the Fittings (Ironwork) complete for Two or Four Settings of seven Retorts.

Address, with full particulars, the SECRETARY, Gas-Works, Wetherby, YORKS.

WANTED, to purchase Gas Carbon delivered at nearest Station to Gas-Works, in quantities of not less than 4 tons.

Address, stating price per ton and quantity, No. 1766, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a second-hand Beale or other EXHAUSTER, in good condition, to pass about 20,000 cubic feet of Gas per hour.

Address, stating particulars and price, No. 1889, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THE Directors of the Monte Video Gas Company, Limited, notify Debenture Holders that the DEFINITIVE DEBENTURES and CHEQUES for the Interest due the 1st of January, 1891, WILL BE READY FOR ISSUE on Monday, the 29th of December, 1890, in exchange for the Banker's Receipts, which must be left at the Company's Offices, three clear days for examination.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE, BAKER, & CO., direct Importers from Ireland. Sample and Price on application. Spent Oxide and Sulphate of Ammonia purchased.

120 and 121, NEWGATE STREET, LONDON, E.C.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and good colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

BENTLEY & CO.

MANCHESTER ELECTRICAL STORES.

FOR Batteries, Bells, Wires, and Special Electrical Apparatus, address the best house

17, NEWTON STREET, PICCADILLY, MANCHESTER.

THE London County Council requires the services of a superior GAS-FITTER with a practical knowledge of Photometry—a thoroughly trustworthy man—to examine and keep in order the Gas-Burners and Fittings in all the Buildings and Premises under the control of the Council, including the Central Offices, the Fire Brigade Stations, the Main Drainage Pumping Stations, and other places. The Salary will be £3 a week; but there will be no Superannuation or Retiring Allowance. The person appointed will be required to give his whole time to the work for which he is employed by the Council, and will not be allowed to do any other work or take any private business. Candidates must, at the date of application, be resident in London, or in the immediate neighbourhood. They must not be less than 35 or more than 45 years of age.

Applications, stating age, qualifications, and previous experience, must, with recent testimonials (not exceeding three in number) attached, be addressed to the Clerk of the London County Council, Spring Gardens, S.W., and endorsed on the cover, "Application for Post of Gas-Fitter." They must be delivered at the Office of the Council not later than Five o'clock on Monday, the 12th of January.

Any application which fails in any respect to comply with the terms of this advertisement will not be laid before the Council.

Personal canvassing is strictly forbidden.

H. DELA HOOKE,
Clerk of the Council.

Spring Gardens, Dec. 24, 1890.

FOR SALE—Seven Purifiers, 15 feet square, with Sieves, Connections, Valves, and Lifting Apparatus complete.

One PURIFIER, 20 ft. by 16 ft., with Sieves, Connections, Valves, and Lifting Apparatus complete.
Two Wrought-Iron TANKS, 8 feet diameter by 7 feet and 6 feet respectively.
One REID'S GAS WASHER.
Two Cast-Iron TANKS, 15 ft. 8 in. diameter by 11 ft. 4 in. and 8 ft. 6 in. respectively.
Two EXHAUSTERS (Jones), equal to 25,000 cubic feet per hour.
A number of 15-inch and other VALVES.
A quantity of SHAFTING and PULLEYS.

J. HEPWORTH,
Gas-Works, Carlisle,
Nov. 14, 1890.

FOR SALE—Gas Plant complete. Gas-holder, 30 ft. by 10 ft.; Two Purifiers, 6 ft. by 3 ft. 6 in.; Retort-House Fittings, Condenser, Washer, Governor, Station Meter, and 4-inch Connections.
Apply to GEO. E. WOODFORD, RUABON.

HALIFAX CORPORATION GAS-WORKS.

THE Halifax Corporation are prepared to receive TENDERS (*a*) for the supply of SULPHURIC ACID and OXIDE, and (*b*) for the purchase of SPENT OXIDE OF IRON for the year ending the 31st of December, 1891.
Full particulars and forms of tender may be obtained on application to Mr. Thomas Holgate, F.C.S., Gas-Works, Halifax.
Sealed Tenders, endorsed "Sulphuric Acid," "Oxide," or "Spent Oxide," as the case may be, to be delivered to the undersigned not later than the 8th of January, 1891.
The Corporation do not bind themselves to accept the lowest, highest, or any tender.
KEIGHLEY WALTON,
Town Clerk.
Town Hall, Halifax, Dec. 24, 1890.

THE GASLIGHT AND COKE COMPANY.

NOTICE is hereby given, that the TRANSFER BOOKS of this Company, so far as they relate to the Company's Capital Stocks WILL BE CLOSED on the Evening of Tuesday, the 6th day of January next, and be re-opened immediately after the Half-Yearly Meeting of the Company, to be held in the month of February next.
By order,
JOHN ORWELL PHILLIPS,
Secretary and General Manager.
Chief Office: Horseferry Road,
Westminster, S.W., Dec. 27, 1890.

FOR DISTRIBUTION WITH GAS ACCOUNTS.

A 4pp. Leaflet, entitled "The Use of GAS-STOVES IN OUR HOMES;" being a reprint of an article from the *Home Provider*. Price 3s. 6d. per 100. Special quotations for larger quantities, and, if required, for printing Gas Company's own announcement on first or last page. Specimen copy, free by post, 1½d.
May be obtained of S. H. E. FOXWELL, Office of the *Home Circle and Provider*, 48, Temple Chambers, TEMPLE AVENUE, E.C.; and of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

Price 2s. per dozen, or 10s. 6d. per 100, post free.

CONSPIRACY and Protection of Pro-perty Act. It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.
Printed copies of this Section, in large type, on broad sheets, may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.
*** *The Act extends to Scotland and Ireland.*

MR. W. H. BENNETT having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their Inventions may be secured for Twelve months; or LETTERS PATENT, which are granted for Fourteen Years.
Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.
Patents procured for Foreign Countries.
Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 22, Great George Street, WESTMINSTER.

PRICE'S PATENT COKE & COAL BARROW

effecting a great saving of time, labour, and expense.
For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee, 22, Alwyne Road, Canonbury, LONDON, N.

Prices are Reduced.

Now Ready, price 15s., limp cloth, the Tenth Yearly

ANALYSIS OF THE ACCOUNTS
OF THE
Metropolitan Water Companies,

Chelsea, East London, Grand Junction, Kent, Lambeth, New River, Southwark and Vauxhall, and West Middlesex. Showing the Capital, Income, Expenditure, Profits, and Dividends per Million and per Thousand gallons of Water supplied; the proportion of Expenditure and Profits to gross Income; and the Income, Expenditure, and Profits per House, &c., supplied for the year ended December 31, 1889, or March 31, 1890, together with the quantity of water supplied, the estimated daily quantity supplied for domestic and other purposes the quantity supplied per head of population, &c., &c., for the year ended December 31, 1889.

Compiled and arranged by
ALFRED LASS, F.C.A.

LONDON:
WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

HOLMSIDE GAS COALS.

THE Owners of Holmside and South Moor Collieries possess an undivided area of nearly 5000 acres of COAL in the County of Durham, over the greater portion of which area the most of the best Coal of the district, including the well-known Hutton Seam, remains almost untouched; and as preparations are being made for working the Hutton Seam on a large scale, it is expected that the reputation of HOLMSIDE GAS COALS will be still further increased. The Holmside and South Moor Collieries have been in the hands of the same families for over half a century; but, until lately, no adequate attempt has been made to open out their very large Coal-Field, notwithstanding that the best Coal of the district around them, and especially the Hutton Seam, has been for some time past seriously diminished by reason of the vigorous workings of neighbouring coal-owners. Holmside Gas Coals are now being worked out of Holmside and South Moor Collieries at a rate of about 2200 tons per working day—a rate totally inadequate to meet the existing demand. By an extensive development of workings in the Hutton Seam, it is hoped that the demand may be fully met, and the quality raised to the highest point attainable by Durham Coal.

For price and particulars, apply to MARK ARCHER, Holmside and South Moor Offices, Quayside, NEWCASTLE-ON-TYNE.

JAMES NEWTON & SONS,
(Established 1820)
FIRE-BRICK AND TILE MERCHANTS,
Wholesale and for Exportation,
FALCON DOCK, 78 AND 79, BANKSIDE,
SOUTHWARK, LONDON, S.E.
DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES and FIRE-CLAY, and every Article suitable for
GAS AND WATER WORKS.

FIRE-BRICKS.
FIRE-CLAY.

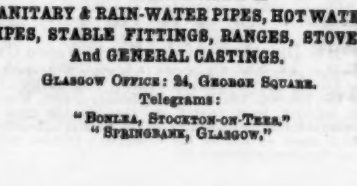
JAMES WHITE & CO.,
Albert Oil-Works,
WIDNES, LANCASHIRE.
Sole Proprietors of the Largest and Purest Beds of Fire-Clay in England.

FOR GAS FURNACES our GANNISTER and SILICA FIRE-BRICKS are acknowledged to be the best and most durable in the market.

GANNISTER and SILICA FIRE-CLAY guaranteed of the Purest and Finest Quality.

ANALYSIS AND REFERENCES ON APLICATION.

GAS AND WATER PIPES.
1½ to 12 IN. BORE.



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Yield of Gas per ton	13,155 cub. ft.
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Coke per ton	1,301·88 lbs.

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Is Weck's Patent arrangement of Three-Way Disc Valves, either separate for Purifiers fixed in line, or arranged together as a
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When the Purifiers are fixed in square.
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VALVES
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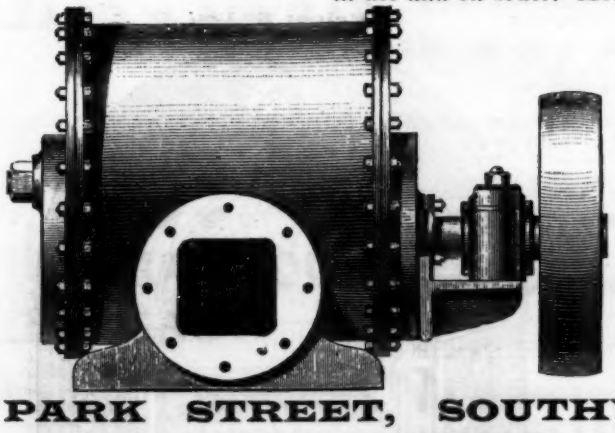
With or without Engine combined. To pass up to 300,000 cubic feet per hour. Nearly 200 in use and on order. Model sent for inspection.



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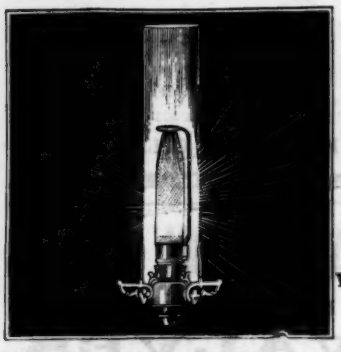

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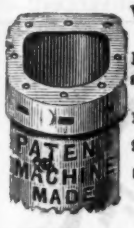

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Prices and Analysis of all the Scotch Cannels on application.

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PREPARED OXIDE OF IRON
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As extensively used in Yorkshire, Lancashire, the Midlands, and Abroad.
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For Illustrated Description, see Advt. p. 1128.

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These Cannels will rank with the Australian Shale for Gas Manufacture.

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This Meter has a simple Automatic arrangement fitted, whereby, upon the insertion of a shilling, a supply of gas can be obtained, and which is cut off on the quantity paid for being consumed. The Meter gives warning when the quantity is nearly exhausted, so that another shilling may be inserted. There is, however, no occasion to wait until this happens, as a second shilling can be inserted after two-pennyworth of the first shilling has been consumed.

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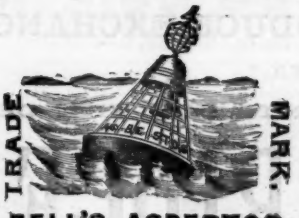

BELL'S ASBESTOS.

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IS FIRE RESISTING.
IS WASHABLE.
IS NON-POISONOUS.
IS MANUFACTURED IN ALL USEFUL COLOURS.
IS IMPERVIOUS TO HEAT, COLD, OR WATER.
IS WITHOUT SMELL.

No expensive Oil or Turpentine required.

WILL NEVER BLISTER.

HAS A COVERING CAPACITY 40 PER CENT. GREATER THAN LEAD PAINTS.

For Outside or Inside Work in any Climate.

Bell's Asbestos Aquol Paint is equally suitable for the finest decorative work as well as for general painting. It can be applied over or under any other paint, and, owing to its easy application, can be used with a large distemper brush; the SAVING THUS EFFECTED IN LABOUR BEING **50** PER CENT. OVER THAT OF LEAD PAINTS.

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BELL'S ASBESTOS AQUOL PAINT is specially adapted for Private Houses, Exhibition Buildings, Ships, Churches, Asylums, School Boards, Railway Stations, and all work of Wood, Iron, Cement, Plaster, Stone, Brick, &c., &c.

Those who Study Economy and Protection from Fire should use only

BELL'S ASBESTOS AQUOL PAINT.

BELL'S ASBESTOS AQUOL PRIMING is made Ready for Use.
BELL'S ASBESTOS AQUOL PRIMING stops all suction of Wood, Cement, Plaster, &c.
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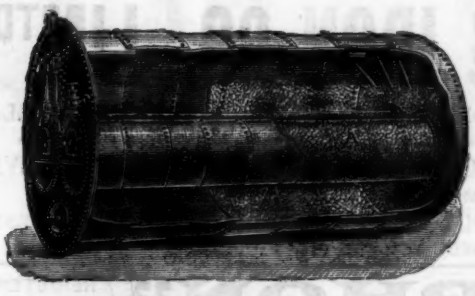
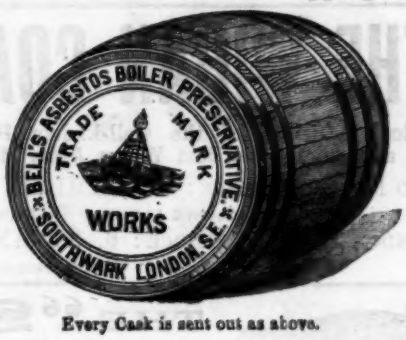
BELL'S ASBESTOS BOILER PRESERVATIVE

Will remove Incrustation from Steam-Boilers of all kinds without chipping.



A shows Boiler Plates when incrusted.
B shows Boiler Plates when cleaned by this Composition.



Every Cask is sent out as above.

The action of this **BOILER PRESERVATIVE,** by absorbing the free oxygen that is in the water, **entirely checks pitting and corrosion.** It also disintegrates incrustation so immediately as to prevent its adhering to the plates; and the deposit falls to the bottom in a loose powder, which is easily swept out. By keeping boilers clean, a **great economy of fuel is effected,** and the danger of the plates burning is entirely obviated; thus avoiding the great risks which are inseparable from scaled plates, lengthening the life of a boiler, and **covering its own cost a hundredfold.** Whenever possible it should be used through Feed Pump or Injector, which it will also keep clear from incrustation. The small quantity required to effect its purpose makes this the most economical, and more than repays the higher price we charge for a fluid which, in the case of many other makers, is useless.

QUANTITY REQUIRED A quarter of a pint weekly per horse power indicated; where the water is very bad rather more, or one pint for every 700 gallons of water evaporated.

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YARN AND SOAPSTONE PACKING
BEST LOCOMOTIVE PACKING made.

BELL'S
COMPOUND HYDRAULIC PACKING
Is specially suited for
Hydraulic Machinery, Accumulators and Ammonia and all Pumps.

BELL'S ASBESTOS LUBRICANT
Is unequalled
For Steam-Engines & Cylinders, Gas-Engines, and every class of machinery.

BELL'S ASBESTOLINE
The reputation of this Lubricant is based on the experience of thousands of users, which places it far in advance of those who rely only on mere laboratory tests.

ASBESTOLINE IS THE CHEAPEST MOST EFFICIENT, CLEANEST MOST INODOROUS AND SAFEST LUBRICANT.

ASBESTOLINE HAS SAVED 90 PER CENT. OVER OIL.
Has been used for all purposes, AND BEATEN ALL OTHER LUBRICANTS IN ACTUAL WORK.

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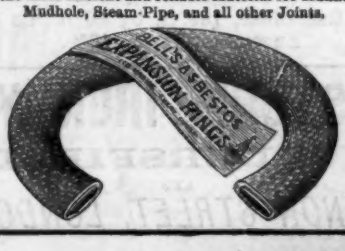
EXPANSION SHEETING
RINGS, AND TAPE.
Is the most efficient and reliable Material for Manhole, Mudhole, Steam-Pipe, and all other Joints.



BELL'S ASBESTOS
NON-CONDUCTING COMPOSITION.
Can be applied when the many years' service.
Is sent out dry in bags; therefore cheaper than others sent out wet.
Will reduce loss by radiation and saves 40 per cent. of fuel.
Is superior to any other, and saves its cost in a few months.

ALL BAGS ARE MARKED AS ABOVE.

BELL'S ASBESTOS
BOILER PRESERVATIVE
Will effectually keep Boilers clean, and remove any Incrustation, without injury to the Boiler, Plates, or Fittings.

GAS COAL.

BEST
REAL OLD SILKSTONE GAS COAL.
Address, THE STRAFFORD COLLIERIES COMPANY,
Near BARNSLEY, SOUTH YORKSHIRE.

THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

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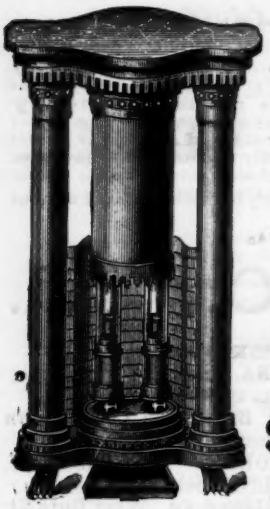
TELEGRAPHIC ADDRESS: "WIGAN BIRMINGHAM." TELEPHONE No. 200.
LONDON DISTRICT OFFICE: 6, STRAND, LONDON—C. PARKER & SON, SOLE AGENTS.
TELEGRAPHIC ADDRESS: "PARKER LONDON."



THE "SYPHON" (REGISTERED TITLE.)
(CLARK'S PATENT.)

Hygienic Gas-Heating Stoves

For Use Without a Flue.

NO FLUE REQUIRED. NO SMOKE. NO SMELL.
NO DIRT OR TROUBLE. NO DANGER.

All sulphurous Vapours are condensed inside the Stoves, and passed off as liquid into the tray beneath.

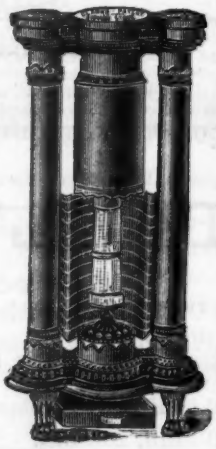
The "SYPHON" Hygienic Gas-Heating Stoves gives a pure, equable, and agreeable heat which can be graduated and sustained at the will of the user. They are so constructed that a moist or dry atmosphere is obtained at pleasure.

They are the Only Safe Stoves for use in Greenhouses, Conservatories, Bed-rooms, &c., and especially suitable for Halls, Sitting-Rooms, Offices, Shops, Schoolrooms, and Theatres.

Adopted by the principal Gas Companies throughout the Kingdom.

Illustrated Price Lists on application to

S. CLARK & CO., Patentees and Makers,
Syphon Works, Park Street, Islington, London, N.
Telgraphic Address: "Syphon Stoves London."



W. C. HOLMES & CO.,

CONTRACTING GAS ENGINEERS.

SPECIALITIES.

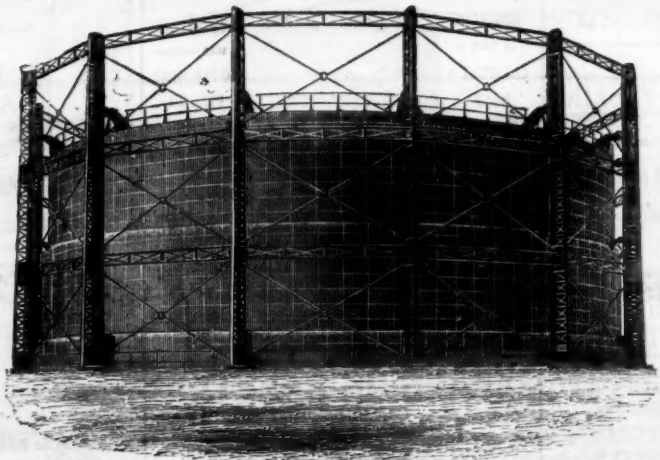
Patent Regenerative Retort-Settings.

Patent Rotary Scrubber-Washer.

Patent Reciprocating Exhauster.

Patent Regulator.

Patent Anti-Dip Pipes.



Treble-Lift Gasholder, 130 ft. by 66 ft., as erected at Burton-on-Trent, 1889.

SOLE MAKERS OF
DRAKE'S
PATENT
GAS PLANT
Specially adapted for Country Places, and for mixing with Coal Gas to increase Illuminating Power.

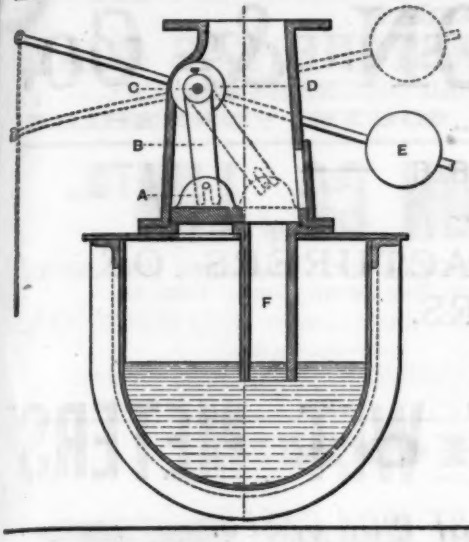
Condensers, Scrubbers, Purifiers, and all Fittings for Gas-Works.

IMPROVED CHEMICAL PLANT.

Telegrams:
"Holmes Huddersfield."
"Ignitor London."

WHITESTONE IRON-WORKS,
HUDDERSFIELD,
AND
80, CANNON STREET, LONDON, E.C.

Illustrated Catalogues on application.



MEIKLEJOHN'S
PATENT
IMPROVED SLIDE-VALVE ANTI-DIP

Is perfectly reliable in action, and requires no attention.
Has all the advantages of the Dip and Anti-Dip combined.
Is cheap, and easily fixed to any form of main.
Will save more than their cost in one season's working.

MR. THOS. NEWBIGGING'S REPORT.

5, Norfolk Street, Manchester, Dec. 11, 1889.

Sir,—I have examined your Anti-Dip arrangement, and have seen it at work on the Retort-Benches at the Longwood Gas-Works, and the opinion which I have formed of its simplicity and certainty in working is distinctly favourable; so much so *that I consider it to be, without exception, the most efficient Appliance of the kind which has yet been introduced.* It can be applied to existing Benches with great ease, and at a minimum cost. So far as I am aware, it embodies a principle of action not previously applied in this direction.—Yours truly, Thos. Newbigging.

Further particulars from the Sole Patentee and Manufacturer,

NEILL MEIKLEJOHN,
GAS ENGINEER,
LONGWOOD, HUDDERSFIELD.

Wrought-Iron
TUBES
And Fittings and Accessories.

LAMBERT BROS., WALSALL,
MANUFACTURERS OF
WROUGHT-IRON TUBES & FITTINGS for GAS, WATER, & STEAM,
BRASS GAS-FITTINGS, GAS-VALVES, STEAM & WATER VALVES, TOOLS, &c.; AND OF
WARNER'S PATENT MARKET GAS STAND-PIPE.
LONDON: T. LAMBERT & SONS, Short Street, LAMBETH.

Cheapest and Best in the Market.
No. 5 burns 5 to 7 ft. of Gas per hour; and No. 10, 10 to 12 ft.
Priced complete with Governor, Bye-pass Tap, &c.

THE POPULAR.

Iron-decorative Body with Enamelled Tube and Consumer.
No. 5 45s. each,
No. 10 63s. „

The
LAMP MANUFACTURING COMPY., LIMITED.
Sole Licensees of
THE FULLFORD GAS-LAMP
(PATENT).

The flame of the Fullford Lamp when first lighted goes immediately into action without any explosion; and after a few minutes, burns with great steadiness and brilliancy.

AGENTS WANTED EVERYWHERE.
LARGE DISCOUNT. LIBERAL TERMS.

Price List forwarded Free on Application.

PHŒNIX WORKS,
45, CITY ROAD, LONDON, E.C.

THE FRAME.

Electro-bronzed Body and Frame with painted Enamelled Tube. Very elegant.
No. 5 85s. each.
No. 10 100s. „

Simple, Economical, Reliable,
Easy to light as an ordinary Flat-Flame Gas-Burner.
Save your Gas and your Eyes.

WILLEY & CO.,
GAS ENGINEERING WORKS, COMMERCIAL ROAD, EXETER.
London Offices: 6 & 7, KING WILLIAM STREET, E.C.
MANUFACTURERS OF EVERY DESCRIPTION OF
GAS APPARATUS,

GASHOLDERS, Telescope and Single-Lift, any size. Some of the largest in the Kingdom erected by this Firm are giving the highest satisfaction.

PLANS and SPECIFICATIONS furnished for **Extensions** and **Enlargement** of existing **Works,** adapting them to the most **Improved** and **Modern Principle** of **Gas Manufacture.**

PURIFIERS, CONDENSERS, WASHERS, ENGINES and EXHAUSTERS, STATION METERS and GOVERNORS, manufactured and erected.

Makers, by permission of that eminent authority **Mr. GEORGE LIVESEY,** of his **CELEBRATED PATENT WASHER,** highly approved by all the Engineers of Works where adopted. Largely in demand.

Special reference and attention are invited to our

WET AND DRY METERS,

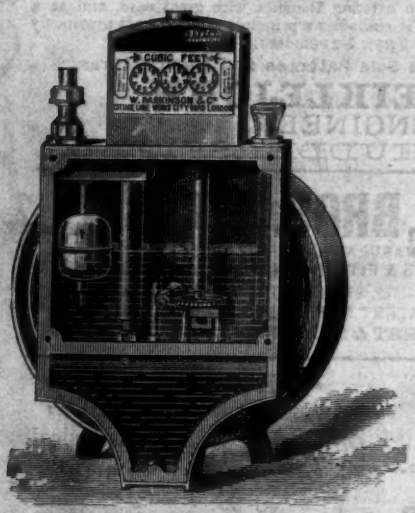
which have acquired a high reputation for the **excellence** of Materials and Workmanship; their **durability** and **accuracy** of **Register** guaranteed. They are used by several of the **London Gas Companies,** and over **200 Provincial Gas Companies.**

Price Lists, Specifications, and Estimates provided for any work appertaining to Gas Lighting, from the Retort-House to the Drawing-Room.

W. PARKINSON & Co.

— ESTABLISHED 1816 —

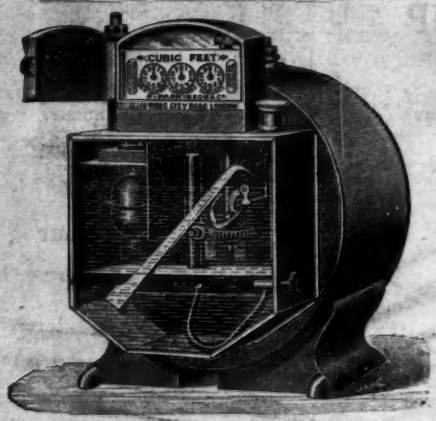
THE ORIGINAL MANUFACTURERS OF WET METERS.



ORDINARY WET METERS

IN CAST-IRON CASES.

Work with very little friction. Will stand very high pressures. Cannot possibly be shut off by sudden increase of pressure, the Float being affected by Outlet Gas only. Allow for loss of water by evaporation without materially affecting the registration or shutting off the gas. Unexcelled for simplicity of construction, excellence of workmanship, or accuracy in registration.



COMPENSATING METERS

IN TINNED OR CAST-IRON CASES.

The Slow-Spoon Compensator has been in extensive use for many years; it maintains an unvarying water-line without appreciable friction, and provides a large reserve of water. The Float arrangement allows sudden or excessive pressure on the Inlet without affecting the working of the Meter or extinguishing the Lights.

DRY METERS.

These Meters are unsurpassed for accuracy of registration. The cases are made of the best Charcoal Tin Plates; and each part of the Meter is stamped by special Machinery to ensure uniformity and exactness in construction. The Diaphragms are all of the best Persian Sheep Skins, carefully selected, and the brasswork and smaller fittings are of superior workmanship.

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LONDON.
Telegraphic Address: "INDEX."

BELL BARN ROAD WORKS,
BIRMINGHAM.
Telegraphic Address: "GAS-METERS."

OFFICE: 10, MAWSON'S CHAMBERS, DEANSGATE,
MANCHESTER.
Telegraphic Address: "PRECISION."
See also Advt., p. 1390.

London: Printed by WALTER KING (at the Office of King, Sell, and Railton, Ltd., 13, Gough Square); and published by him at No. 11, Bell Court, Fleet Street, in the City of London.—Tuesday, Dec. 30, 1890.